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GANNETT FLEMING CORDDRY AND CARPENTER INC HARRISBURG PA F/G 13/2
NATIONAL DAM INSPECTION PROGRAM. LOCUST LAKE DAM (NDS-ID-PA-006--ETC(U)
SEP 78 DACW31-78-C-0046

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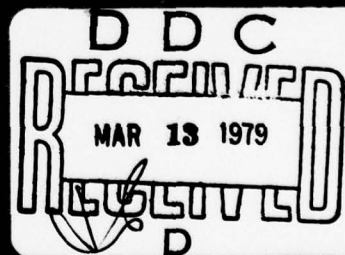
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DELAWARE RIVER BASIN

LOCUST CREEK, SCHUYLKILL COUNTY

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National Dam Inspection Program. Locust Lake Dam (NDS-ID-PA-00666, DER-ID-54-164) Delaware River Basin, Locust Creek, Schuylkill County, Pennsylvania. Phase I Inspection Report.

LOCUST LAKE DAM

NDS ID No. PA-00666
DER ID No. 54-164

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DACW31-78-C-0046

COMMONWEALTH OF PENNSYLVANIA

11 Sep 78

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

12/81p

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

SEPTEMBER 1978

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DELAWARE RIVER BASIN
LOCUST CREEK, SCHUYLKILL COUNTY
PENNSYLVANIA

LOCUST LAKE DAM

NDS ID No. PA-00666
DER ID No. 54-164

COMMONWEALTH OF PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SEPTEMBER 1978

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam: Locust Lake Dam
NDS ID No. PA-00666;
DER ID No. 54-164

Owner: Commonwealth of Pennsylvania

State Located: Pennsylvania

County Located: Schuylkill

Stream: Locust Creek

Date of Inspection: 17 August 1978

Inspection Team: Gannett Fleming Corddry and
Carpenter, Inc.
Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations, and past performance, Locust Lake Dam is judged to be in very good condition. The spillway will pass the Probable Maximum Flood (PMF) without overtopping the dam. Based on criteria established for these studies by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway capacity is rated as adequate. Neglecting the effects of surcharge storage, the spillway can accommodate a flood with a peak inflow of 143 percent of the PMF peak flow.

In view of the concern for the safety of Locust Lake Dam, the following measures are recommended to be undertaken by the Owner immediately:

(1) Raise the riprap on the upstream slope of the embankment to the top of dam elevation.

(2) Develop a detailed emergency warning system for Locust Lake Dam.

In order to correct operational, maintenance, and repair deficiencies and to more accurately assess the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Install two or more observation wells, or other instrumentation, downstream from the axis of the dam. The instrumentation should be located in the vicinity of the wet area at the toe of the embankment to determine the water level in the downstream embankment. Periodically monitor and record the water levels and continue to observe the wet area so that any change in conditions is apparent.

(2) Fill in the area that has undergone surface erosion. Reestablish the vegetal cover over the affected area.

(3) Visually monitor the two small cracks on the intake structure deck. Also visually monitor the fine crack in the right wall of the outlet conduit. If changes are noted, take appropriate action.

In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency warning system procedures.

(2) In view of the minimal protection for seepage through the embankment, the downstream embankment slope should be monitored for wet areas that might develop in the future.

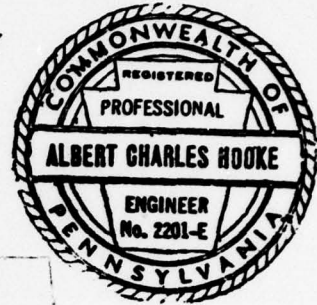
Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. Hooke

A. C. HOOKE
Head, Dam Section

Date: 26 October 1978



Approved by:

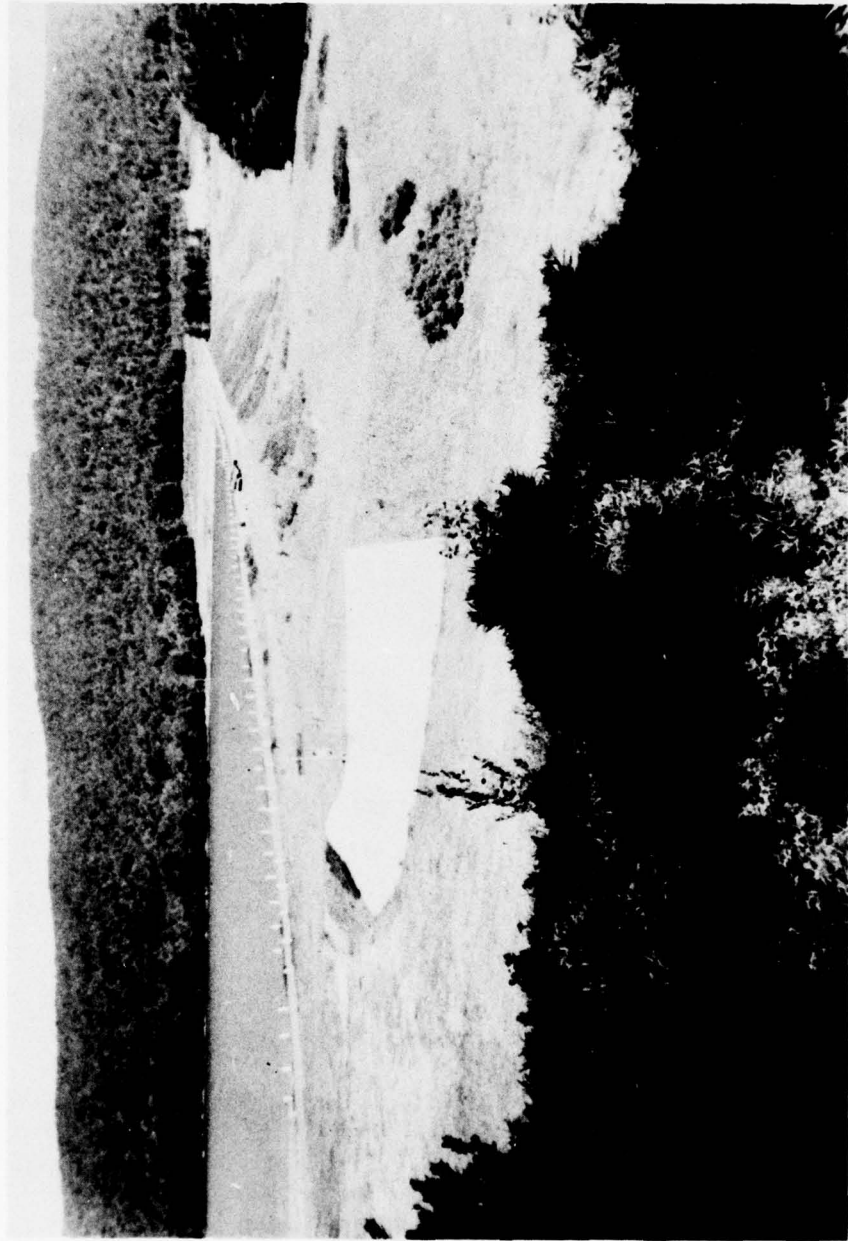
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. Withers

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date: 11 Dec 78

LOCUST LAKE DAM



Spillway and Embankment View from the Right Hillside.

DELAWARE RIVER BASIN
LOCUST CREEK, SCHUYLKILL COUNTY
PENNSYLVANIA

LOCUST LAKE DAM

NDS ID No. PA-00666
DER ID No. 54-164

COMMONWEALTH OF PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

ABSTRACT

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project. ABSTRACT

a. Dam and Appurtenances. Locust Lake Dam consists of an original homogeneous earthfill embankment and an additional embankment that was placed on the upstream face of the original embankment about 16 years after the original structure was constructed. The existing embankment is 1,460 feet long and is 46 feet high at the maximum section. The spillway is

located at the right abutment. The spillway is a grass-covered trapezoidal channel with a bottom width of 65 feet and side slopes of 1V on 2H. The outlet works is located near the center of the embankment. The intake structure, an 8-foot square drop inlet, acts as a service spillway in that it controls the normal pool elevation. A 24-inch RCP, which is controlled by a 24-inch by 36-inch slide gate, serves as the reservoir drawdown facility. The conduit downstream from the intake structure is a 6-foot square reinforced concrete structure. Discharge from the conduit flows into a derrick stone lined stilling pool. Discharge from the stilling pool flows into a small lake that is created by a small dam (DER I.D. No. 54-162) located just downstream from Locust Lake Dam.

b. Location. The dam is located on Locust Creek in Ryan Township about 8 miles west of Tamaqua, Pennsylvania, and is approximately 6 miles upstream from the confluence of Locust Creek and Little Schuylkill River. Locust Lake Dam is shown on USGS Quadrangle, Delapo, Pennsylvania, with coordinates N40°46'50" - W76°07'10" in Schuylkill County, Pennsylvania. The location map is shown on Plate 1.

c. Size Classification. Intermediate (46 feet high, 1,400 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Locust Lake Dam (Paragraph 5.1e.).

e. Ownership. Commonwealth of Pennsylvania.

f. Purpose of Dam. Recreation.

g. Design and Construction History. The original Locust Lake Dam was constructed about 1954 by the Marchalonis Brothers as a fishing area. The initial engineering plans and sections were prepared by H. D. Artz, the consulting engineer for the Marchalonis Brothers. Completion of the original structure was interrupted by cost overruns, and the spillway was not built as specified in the plans

approved by the Commonwealth of Pennsylvania, Department of Forests and Waters, Division of Dams and Encroachments.

The dam and the surrounding land were acquired by the Pennsylvania Bureau of State Parks in 1966 for further development of the Tuscarora State Park project under the Project 70 program. Tuscarora State Park is centered around Tuscarora Dam, also known as Locust Creek Dam, which is about 4 miles downstream from Locust Lake Dam. The Bureau of Engineering, Department of Environmental Resources, investigated the site and performed the design of the rehabilitation of Locust Lake Dam in 1969. The construction contract was awarded to Sack Brothers, Inc., Jamestown, New York, in June, 1969. The rehabilitation of the dam was completed in November, 1970. Shortly after the completion of the rehabilitation, the area surrounding the reservoir was developed into Locust Lake State Park.

h. Normal Operational Procedure. The reservoir is normally maintained at the service spillway crest level with excess inflow discharging over the drop inlet and through the outlet conduit. The slide gate located at the intake for the 24-inch RCP is normally closed.

1.3 Pertinent Data.

a. Drainage Area. 1.7 square miles.

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite - 315 (approximate discharge for June 1972 Flood).

Emergency drawdown line at maximum pool elevation - 110 (approximate).

Combined service and emergency spillway with pool at Elevation 1264.0 - 5,380.

c. Elevation. (Feet above msl.)

Top of dam - 1264.0

Maximum pool - 1264.0.

Normal pool - 1251.0.

Upstream invert outlet works - 1222.0.

Downstream invert outlet works - 1218.5.

Stilling Pool - 1208.0.

d. Reservoir Length. (Miles.) No

Normal pool - 0.44.

Maximum pool - 0.49.

e. Storage. (Acre-feet.)

Normal pool - 620

Maximum pool - 1,400.

f. Reservoir Surface. (Acres.)

Normal pool - 49.

Maximum pool - 73.

g. Dam.

Type - Earthfill embankment.

Length - 1,460 feet.

Height - 46 feet.

Top Width - 30 feet.

Side Slopes - Upstream - 1V on 2.2H.

Downstream - 1V on 2.5H.

Zoning - None.

Cutoff - Earthfilled cutoff trench 14 feet
wide at bottom and 5 feet deep.

Grout Curtain. None.

- h. Diversion and Regulating Tunnels. Two 24-inch and one 12-inch conduits that were removed after the completion of the outlet works.

- i. Spillway.

Type - Grass-covered trapezoidal channel cut into earth and rock.

Width - Bottom width is 65 feet.

Crest Elevation - 1257.0 feet.

Upstream Channel - Grassy approach channel and transverse paved roadway.

Downstream Channel - Grassy channel.

- j. Regulating Outlets

Type - 8-foot square drop inlet structure.
24-inch RCP for drawdown.
6-foot square reinforced conduit through embankment.

Length - 24-inch RCP - 45 feet.
6-foot square conduit - 175 feet.

Access - From downstream outlet.

Regulating Facilities - One 24-inch by 36-inch slide gate. Gate stand is at top of inlet structure.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. Engineering data that was available for review included construction plans, sections, and specifications for the original structure that was built in 1954; the 1954 permit application report by the Division of Dams; progress inspections of the construction of the original structure; plans, sections, and specifications for the rehabilitation of the structure in 1969; the 1969 permit application report by the Division of Dams and Encroachments; and progress inspections of the rehabilitation in 1969-1970.

b. Design Features. The primary features of Locust Lake Dam are the embankment, the earthen channel emergency spillway, and the outlet works. A general plan of the dam is shown on Plate 2. A discussion on geology is presented in Appendix E.

The embankment is 1,460 feet long and is 46 feet high at the maximum section (Photographs A through E and G and Plate 8). The embankment consists of the original embankment, which was 1,210 feet long and was 38 feet high at the maximum section, and the additional embankment that was placed in 1969-1970, which was placed on the upstream face of the dam. A 12-inch thick blanket of riprap on a 6-inch thick filter blanket was provided on the upstream face between Elevation 1244.0 and Elevation 1254.0. The upstream face is seeded above Elevation 1254.0. The slope of the upstream face is 1V on 2.2H. A cutoff trench was excavated to a depth of 5 feet and bottom width of 14 feet along the upstream toe and was backfilled with impervious material. The width of the top of dam is 30 feet, and 20 of the 30 feet is a paved roadway. The slope of the downstream face is 1V on 2.5H, and the downstream face has a grass cover. Rockfill and an 18-inch filter blanket were provided at the downstream toe of the embankment to Elevation 1235.0. The rockfill was placed on a 1V on

2H slope, and there is a 10-foot rockfill berm between the downstream slope of the embankment and the slope of the rockfill. In 1972, after seepage had been observed in the area, a system of drainage ditches was constructed downstream from the toe to the left of the outlet works. The main component of the drainage system is a 3-1/2-foot wide, 80-foot long rockfill ditch that extends from the toe area to a small lake downstream of the dam. The main ditch is about 100 feet to the left of the outlet works. An open ditch along the toe that is 2-1/2-feet wide, 80-feet long, and 1 foot deep joins the main ditch at the toe. A lateral rockfill ditch is located 30 feet from the toe and extends 30 feet to the left. A second lateral rockfill ditch is located 50 feet from the toe and extends 20 feet to the right.

The floodplain and abutment areas are composed primarily of sandy shales, moderately to badly broken. A subsurface investigation disclosed large subsurface flows under the dam through the natural valley bed materials. There was not positive cutoff to rock in the original construction or the rehabilitation of the dam. The spillway area consists of coarse sandstones and sandstone conglomerates with a few sandy shales. The overburden is shallow.

The grass-covered emergency spillway is located at the right abutment. The spillway is a trapezoidal channel with a bottom width of 65 feet. The side slopes are 1V on 2H. The control section is at the axis of the dam and its crest is at Elevation 1257.0. The slope of the approach channel is adverse and is approximately 0.57%. The spillway outlet channel slope is 7.5% from the control section downstream for 200 feet, where it decreases to 2% for the remainder of the channel, about 350 feet. From the end of the spillway outlet channel, discharges are directed away from the downstream toe of the embankment and toward the original stream channel of Locust Creek downstream. Approximately 80 feet of the channel side slope on the embankment side is paved with reinforced concrete. A profile along the centerline of the spillway and a typical spillway section are shown on Plate 8. The spillway channel is shown in Photographs I and J.

The outlet works is located near the center of the embankment. An 8-foot by 8-foot reinforced concrete drop inlet is provided for the control of the normal pool elevation. Low discharges flow over the four 8-foot long sides of the intake structure. The crests of the weirs are ogee-shaped, and the crests are at Elevation 1251.0. The structure is 35 feet high. A 24-inch RCP placed on a concrete cradle serves as the reservoir drawdown facility. A 24-inch by 36-inch slide gate on the upstream face of the intake structure is provided to control flow in the RCP. The conduit downstream from the intake structure is a 6-foot by 6-foot reinforced concrete structure. Concrete anti-seep collars are provided along the conduit at intervals of 25 feet. Discharge from the culvert flows into a derrick stone-lined stilling pool. Discharge from the stilling pool flows into a small lake. Outlet works details are shown on Plate 6. A profile along the centerline of the conduit and stilling pool details are shown on Plate 5. The outlet works is shown on Photographs H, K, and L.

2.2 Construction.

a. Data Available. Construction data available for review included project plans, specifications, and construction progress reports for both the original structure and the rehabilitation structure.

b. Construction Considerations.

(1) Embankment. Review of the project plans and specifications did not yield any concerns with respect to the character of the work. The construction progress reports for the original structure filed by the engineer indicate that the embankment was well compacted. The right end of the embankment had been overtopped due to heavy rains in May, 1954, when the embankment was 25 feet high. No damage had been done, and the overtopping was of little concern. Inspections by the Commonwealth in 1954 and 1958 revealed that the embankment had not been completed due to lack of funds and that the construction permit had expired. Under an extension of the permit, the embankment was apparently completed in 1959. Notes in the Pennsylvania Department of Environmental Resources (PennDER) files indicate that a soil

analysis had been made for the embankment around 1968 and that there was concern for several reported conditions. The density of the embankment was not uniform, and the majority of the embankment was not well compacted. Large void areas were evident by loss of wash water and zones of poor or no recovery in soil sampling. A zone was discovered where fines had migrated toward the foundation and the downstream toe. The construction progress reports filed for the rehabilitation of the dam in 1969-1970 by the resident engineer do not indicate any concerns with the character of the embankment work.

(2) Spillway. During the construction of the original structure, the inspecting engineer reported that no work was done on the spillway. An inspection by the Commonwealth in 1958 revealed that a spillway had been constructed, but the spillway was not in compliance with the plans. The spillway was completely redesigned and rebuilt for the 1969 rehabilitation of the dam. Review of the available data for the existing spillway did not yield any concerns with respect to the character of the work.

(3) Outlet Works. Review of the available data for the outlet works did not yield any concerns with respect to the character of the work.

2.3 Operation. The Division of Completed Projects, Commonwealth of Pennsylvania, supplied "Operation and Maintenance Manual for Locust Lake Dam," which provides the park forces general information on the history of the dam, pertinent data, operating procedures, inspection procedures, rating curves for the conduit and emergency spillway, and instruction manuals for the operating equipment. Inspections of the dam are made twice each year by the park superintendent, who forwards the reports to the Secretary, Department of Environmental Resources, in Harrisburg. In addition, the Division of Completed Projects conducts annual inspections of the dam.

2.4 Other Investigations. As far as is known, there have been no investigations of the dam other than those described herein.

2.5 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, and by the Division of Completed Projects, Bureau of Operations. Additional information is available from the Bureau of Engineering, but it was not available for review for this study. The Owner made available personnel for information and operating demonstrations during the visual inspection.

b. Adequacy. The type and amount of design data and other engineering data, together with visual inspection and computations performed for this study, are sufficient to assess the condition of the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The general appearance of this project indicated that the project features are in very good condition. Some irregularities were noted and are described herein.

b. Embankment. A combination of grass, weeds, and crownvetch with an average height of two feet covers the upper portion of the upstream face and all of the downstream face except for the rockfill at the toe. The riprap on the upstream slope does not extend to the top of dam. Riprap is provided from Elevation 1244.0 to Elevation 1254.0. There is a wet area at the downstream toe from 100 feet to the left to 180 feet to the left of the outlet structure. Clear water is up to 2 inches deep in the open drainage ditch that is described in Paragraph 2.1b. There is no discernable flow. A 5-foot wide by 20-foot long area has undergone surface erosion near the downstream toe at the left abutment. The area is located slightly above the rockfill. The maximum depth of the erosion is 8 inches.

c. Appurtenant Structures.

(1) Spillway. The spillway approach channel and outlet channel have a grass cover, and the sod is intact and is in good condition. No debris was present, and no abnormalities were observed.

(2) Outlet Works. There is a fine crack about 18 inches long on top of the intake structure deck over the air vent at the southeast corner. There is another crack on the intake structure on the downstream face where the staff gage is bolted to the structure. The crack is about 2 feet long and about 1/8 inch wide. Both cracks are above normal pool elevation. The concrete of the outlet conduit is in very good condition. There is a fine crack in the

right wall of the outlet conduit about 40 feet upstream from the outfall. The crack is vertical and is about 3 feet long. There is no evidence of differential seepage or movement at the crack. A seeping joint in the outlet conduit that had been observed in a 1976 inspection was repaired in 1976.

The 24-inch by 36-inch slide gate was opened about 2 inches by two men in about 10 minutes. No irregularities were observed. It was noted that the air vent for the intake structure would be submerged at maximum pool level. It was also noted that debris could cause blockage of the intake structure.

d. Reservoir Area. The reservoir slopes are predominately wooded. No evidence of creep, rock-slides, or landslides was visible. The Owner indicated that there is no known sedimentation problem. The watershed is primarily undeveloped, although about 60 acres adjacent to the reservoir have been developed into Locust Lake State Park.

e. Downstream Channel. The spillway outlet channel is trapezoidal in shape and slopes downstream on a 2 percent grade. The outlet channel directs spillway flows away from the toe of the dam, but the channel ends about halfway toward the streambed of Locust Creek. Flows are routed through a wooded area before they can enter the creek channel.

The stilling pool is located immediately downstream of the outfall of the outlet conduit. Discharges from the outlet conduit flow through the stilling pool into a small lake just downstream of the pool. Excess inflow into the small lake discharges over a small concrete spillway into the natural channel of Locust Creek.

3.2 Evaluation.

a. Embankment.

(1) Vegetation growth is controlled and maintained by the park forces at regular intervals, and the condition of the cover is not of concern.

(2) There is some concern for the fact that the riprap on the upstream face does not extend to the top of the embankment. General practice is to provide upstream slope protection from the top of the dam to a safe distance below normal pool level. The unprotected portion of the upstream slope could be eroded by wave action during a flood condition.

(3) There is some concern for the wet area at the downstream toe of the embankment. Wet areas were first observed near the toe in 1972, and the drainage ditch system described in Paragraph 2.1b. was built to provide an outlet for the wet areas. Control of the wet area by the drainage ditch system is satisfactory. The general area is being monitored by the park forces.

(4) The surface erosion near the downstream toe at the left abutment is of slight concern. The loss of vegetation at the erosion area reduces the ability of the area to resist further erosion, but, at the present time, the area affected is relatively small.

b. Appurtenant Structures.

(1) There is no cause for concern of the condition of the emergency spillway.

(2) There is slight concern for the two cracks on the intake structure. The cracks are relatively small, and the integrity of the intake structure is not in question. Because the air vent on the intake structure would be submerged at maximum pool level, the ultimate capacity of the outlet works is uncertain. In addition, debris could cause significant blockage of the intake structure and greatly reduce the outlet works capacity.

(3) The fine crack in the right wall of the outlet conduit is of slight concern. The crack is relatively small and fine, and there is no seepage at the crack.

c. Reservoir Area. No conditions were observed in the reservoir area that might present significant hazard to the dam.

d. Downstream Channel. No conditions were observed in the downstream channel that might present significant hazard to the dam. The rockfill at the downstream toe protects the downstream slope of the embankment to Elevation 1235.0. It is not anticipated that the tailwater elevation would exceed Elevation 1235.0.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The project is operated in accordance with the Operation and Maintenance Manual for Locust Lake Dam. The manual provides detailed operating procedures for normal conditions, periods of low flow, periods of flood emergency, and for reservoir drawdown.

a. Normal Procedure. The reservoir is normally maintained at the intake structure crest level with excess inflow going into the drop inlet and the outlet conduit. The 24-inch by 36-inch slide gate is normally closed.

b. Low Flow Procedure. There is no prescribed minimum release for Locust Lake Dam. Several springs downstream from the dam supply Locust Creek year around.

c. Flood Emergency Procedure. During periods of flooding, the slide gate is kept closed. The outlet works passes floodwaters from small floods. The spillway is designed to spill at flood frequencies exceeding 100 years. Continuous patrols are conducted during floods to check for seepage, erosion, and floating debris. Any unusual conditions are reported to the Office of Engineering and Construction, Harrisburg, Pennsylvania.

d. Drawdown Procedure. Drawdown of the reservoir for maintenance and inspection purposes is accomplished by opening the slide gate on the 24-inch RCP, which discharges into the 6-foot square conduit. The Operation and Maintenance Manual specifies that the drawdown rate should not exceed one inch per hour.

4.2 Maintenance of Dam. The Park Superintendent and his staff are responsible for maintenance of the dam. The Superintendent makes a formal inspection of all the features of the dam every six months, and the report is sent to the Secretary, Department of Environmental Resources, Harrisburg, Pennsylvania. In addition, a formal inspection of the dam is also made

by the Division of Completed Projects each year. The Operation and Maintenance Manual contains detailed instructions for inspection and maintenance of the dam and appurtenant structures. The three formal inspections of the dam each year, as well as informal inspections made more frequently, are used to evaluate the need for maintenance. The inspection performed for this study and follow-up reports on file for recommended maintenance indicate that the maintenance of the dam is satisfactory.

4.3 Maintenance of Operating Facilities. The inspection and maintenance program for the operating facilities is similar to the previously described program for the dam. Operation of the gates is performed at least on an annual basis.

4.4 Warning Systems in Effect. There is no formal warning system in effect for the downstream areas. The Park Superintendent said that he would call local authorities in the event of an emergency. The Superintendent or the Park Foreman is available at all times.

4.5 Evaluation. The inspection and maintenance program for the project are satisfactory. The procedures used for normal, emergency, low-flow, and drawdown operations are satisfactory. The lack of an emergency warning system for downstream areas is unsatisfactory.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data.

(1) Hydrologic analysis for the 1969 rehabilitation of Locust Lake Dam closely followed the procedures used by the Soil Conservation Service. The "C" curve discharge for the 1.7 square mile drainage area is 2,200 cfs as shown in the 1969 permit application report by the Division of Dams and Encroachments.

(2) In the recommended guidelines for safety inspection of dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended spillway design flood for the size (intermediate) and hazard potential (high) classification of Locust Lake Dam is the PMF. If the dam and spillway are not capable of passing the PMF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

(3) Included with the report on the application by the Bureau of State Parks to rehabilitate Locust Lake Dam were rating curves for the outlet works and the spillway. With the reservoir at the top of dam level, the outlet works capacity is 880 cfs and the spillway capacity is 4,500 cfs.

(4) The Locust Lake Dam watershed is primarily wooded. About 60 acres of land near the dam have been developed into a state park. The hydrologic analysis for this study was based on the existing condition of the watershed, and the effects of future development of the watershed were not considered.

b. Experience Data. For this study, the PMF peak flow of 7,200 cfs for a 4.8-square-mile watershed that was previously calculated by the Corps of Engineers was transposed to the Locust Lake Dam watershed. The PMF peak flow for Locust Lake Dam was estimated to be 3,140 cfs. The rating curves show that the spillway capacity is 4,500 cfs. This was accepted as the spillway capacity.

The maximum known flood at the damsite is estimated at 315 cfs during Tropical Storm Agnes, June, 1972. The discharge was estimated from the records of the Division of Dams and Encroachments.

c. Visual Observations. On the date of the inspection, no conditions were observed that would indicate that the emergency spillway capacity would be significantly reduced during a flood occurrence. As noted in Section 3, the air vent for the outlet works would be submerged at maximum pool level and its ultimate capacity is uncertain. In addition, debris could cause blockage of the intake structure. Consequently, the outlet works capacity was not included in determining spillway capacity.

d. Overtopping Potential. For an occurrence of the PMF, the peak inflow of 3,140 cfs is less than the spillway capacity of Locust Lake Dam. Therefore, the spillway capacity is sufficient to pass the PMF without overtopping the dam (Appendix C).

e. Downstream Conditions. Locust Lake Dam is about 8 miles west of Tamaqua, Pennsylvania, as shown on Plate 1. Flows from Locust Lake Dam are routed through a small lake immediately downstream of the dam and proceed downstream along Locust Creek about 5 miles to Tuscarora Dam Reservoir. Tuscarora Dam is also called Locust Creek Dam. Locust Creek empties into the Little Schuylkill River about 1 mile below Tuscarora Dam. From Locust Lake Dam to Tuscarora Dam, Locust Creek crosses under three secondary roads and passes near approximately 20 homes and inhabitable structures. Below the confluence with Locust Creek, Little Schuylkill River flows about 2 miles to Tamaqua, which is built-up directly to the banks of the Little Schuylkill River. Along the 2-mile stretch of the Little Schuylkill River from the confluence to Tamaqua, Little Schuylkill River passes under Conrail tracks three times and crosses under one highway. Several homes and petroleum distribution facilities are located adjacent to the river. The road and railroad crossings for Locust Creek and Little Schuylkill River would not provide significant mitigating effects to floodflows. Without considering the conditions at and downstream of Tuscarora Dam, the downstream conditions between Locust Lake Dam and Tuscarora Dam indicate that a high hazard classification is warranted for Locust Lake Dam.

f. Spillway Adequacy.

(1) The spillway is capable of passing the PMF peak inflow of 3,140 cfs without overtopping Locust Lake Dam.

(2) Based on established OCE criteria as outlined in Paragraph 5.1a.(2), the spillway capacity of Locust Lake Dam is rated as adequate. Neglecting the effects of surcharge storage, the spillway discharge capacity of 4,500 cfs can accommodate a flood with a peak inflow that is 143 percent of the PMF peak inflow.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observation.

(1) General. The visual inspection of Locust Lake Dam resulted in two observations relevant to structural stability. These observations are listed herein for the embankment.

(2) Upstream Slope. It was observed that the riprap does not extend to the dam crest. The detailed description and evaluation of the condition are in Paragraphs 3.1b. and 3.2a.(2), respectively.

(3) Downstream Slope. A wet area was located along the toe of the embankment. The detailed description and evaluation of the condition are in Paragraphs 3.1b. and 3.2a.(3), respectively.

b. Design and Construction Data. No records of design data or stability computations were available for review. Results for the 1968 soil investigation are shown on Plates 3 and 4. Construction progress reports for the original embankment and for the 1969 rehabilitation are summarized along with concerns for various conditions discovered in the 1968 soil investigation in Paragraph 2.2b.(1). The available information shows that the upstream slope is about 1V on 2.2H and that the downstream slope is about 1V on 2.5H. The downstream slope of the embankment that was added in 1970 was found to be 1V on 2H and the downstream slope of the original embankment was found to be 1V on 2.7H, as determined by surveys made during this inspection. Analysis of the embankment stability is beyond the scope of this study. It is noted that the drainage features for control of seepage through the embankment are minimal.

c. Operating Records. No formal records of operation were reviewed. There was no information

available for review that indicated any evidence of previous stability problems.

d. Post-Construction Changes. Locust Lake Dam was rehabilitated in 1969-1970, and the embankment was raised approximately 8 feet along with other major changes. A description of the rehabilitation and the revised project features is given in Paragraph 2.1b.

e. Seismic Stability. The dam is located in Seismic Zone I. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on the visual inspection, available records, calculations, and past operational performance, Locust Lake Dam is judged to be in very good condition. However, some deficiencies of varying degree of importance were noted. A summary of features and observed deficiencies is listed below:

<u>Feature and Location</u>	<u>Observed Deficiencies</u>
<u>Embankment:</u>	
Upstream slope	Riprap does not extend to top of dam.
Downstream toe	Wet area and surface erosion.
<u>Outlet Works:</u>	
Intake structure	Two small cracks in concrete.
Outlet conduit	Fine crack in right wall.

(2) The overtopping potential analysis shows that Locust Lake Dam will not be overtopped by the PMF. Based on OCE criteria as outlined in Paragraph 5.1a(2), the existing spillway capacity is rated as adequate. The existing spillway can accommodate a flood with a peak inflow of 143 percent of the PMF.

(3) Stability computations were not performed for this study.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of

visual inspection, past performance, and computations performed prior to and as a part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented as noted therein.

d. Necessity for Further Investigations. No further investigations are required to accomplish the remedial measures outlined in Paragraph 7.2.

7.2 Recommendations and Remedial Measures.

a. In view of the concern for the safety of Locust Lake Dam, the following measures are recommended to be undertaken by the Owner immediately:

(1) Raise the riprap on the upstream slope of the embankment to the top of dam elevation.

(2) Develop a detailed emergency warning system for Locust Lake Dam.

b. In order to correct operational, maintenance, and repair deficiencies and to more accurately assess the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Install two or more observation wells, or other instrumentation, downstream from the axis of the dam. The instrumentation should be located in the vicinity of the wet area at the toe of the embankment to determine the water level in the downstream embankment. Periodically monitor and record the water levels and continue to observe the wet area so that any change in conditions is apparent.

(2) Fill in the area that has undergone surface erosion. Reestablish the vegetal cover over the affected area.

(3) Visually monitor the two small cracks on the intake structure deck. Also, visually monitor the fine crack in the right wall of the outlet conduit. If changes are noted, take appropriate action.

c. In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency warning system procedures.

(2) In view of the minimal protection for seepage through the embankment, the downstream embankment slope should be monitored for wet areas that might develop in the future.

DELAWARE RIVER BASIN
LOCUST CREEK, SCHUYLKILL COUNTY
PENNSYLVANIA

LOCUST LAKE DAM

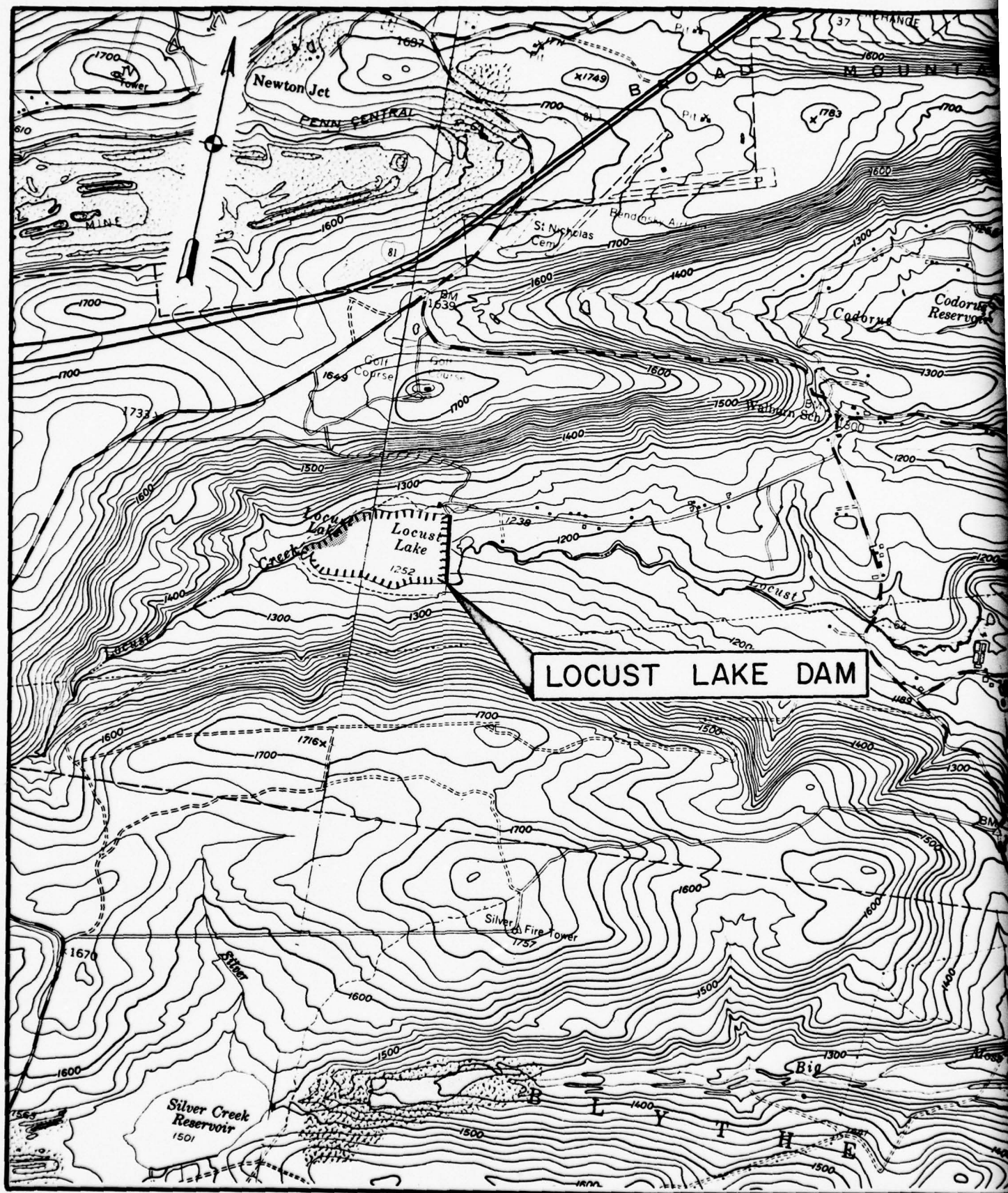
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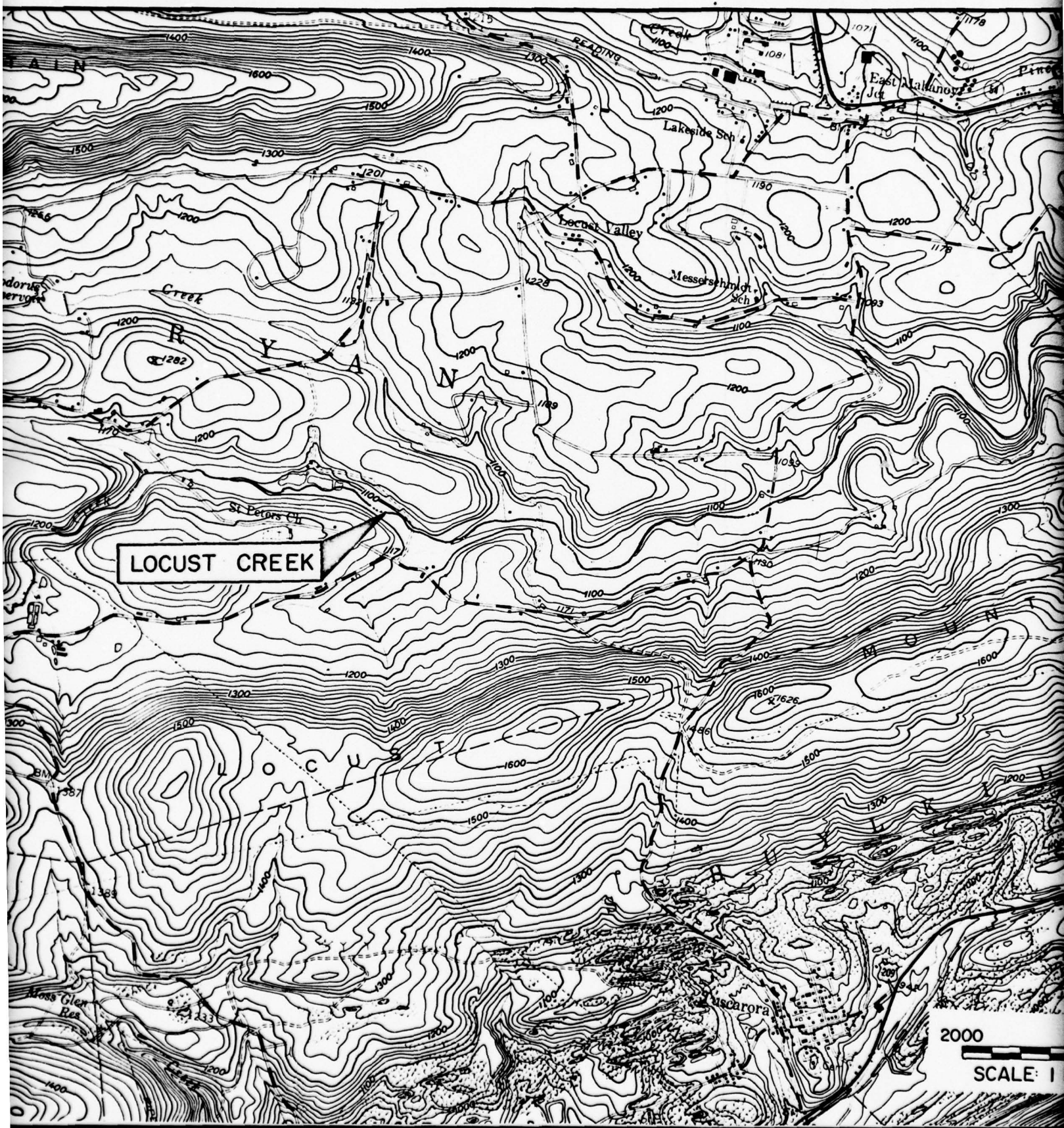
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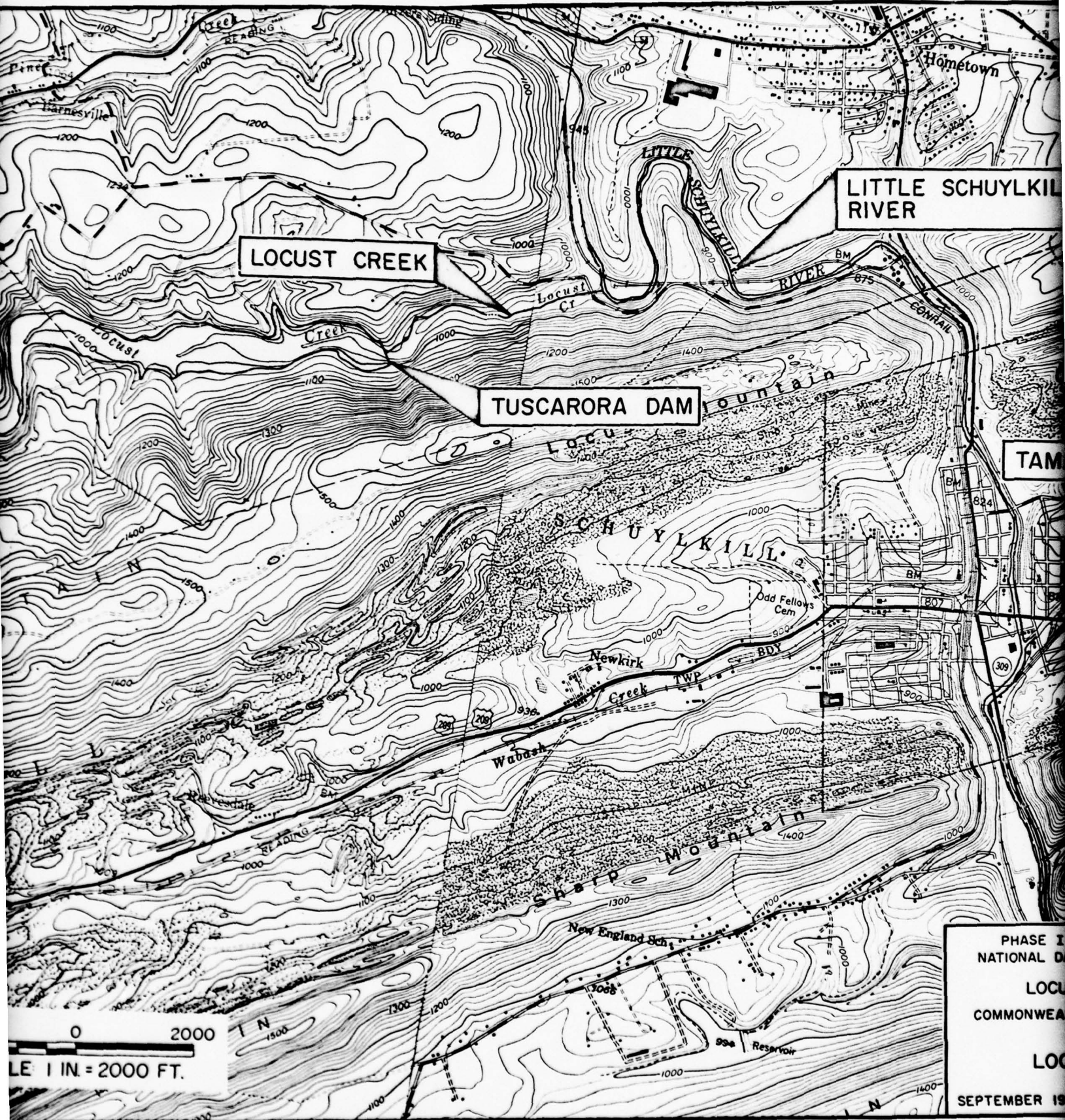
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

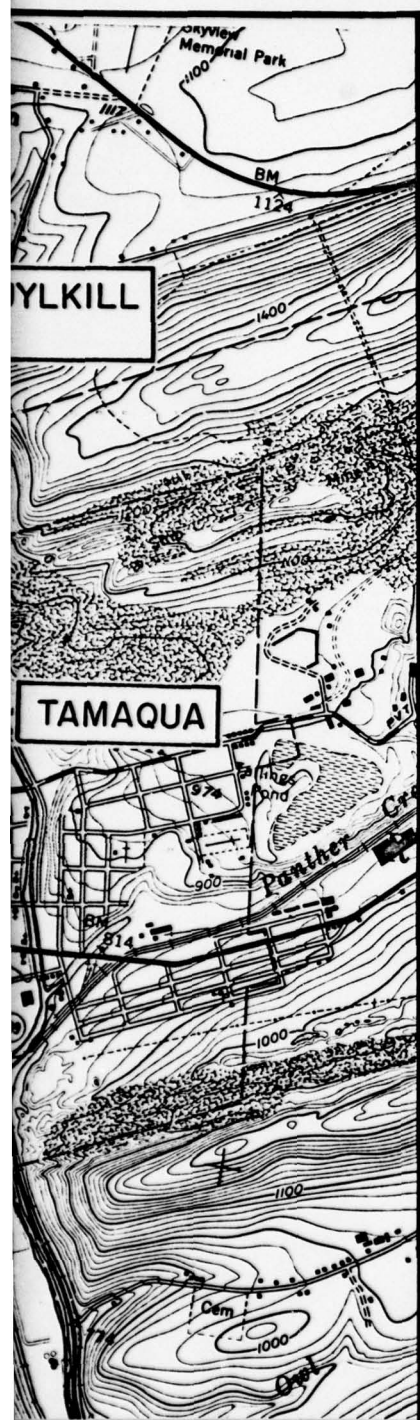
SEPTEMBER 1978

PLATES









PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LOCUST LAKE DAM
COMMONWEALTH OF PENNSYLVANIA

LOCATION MAP

DECEMBER 1978

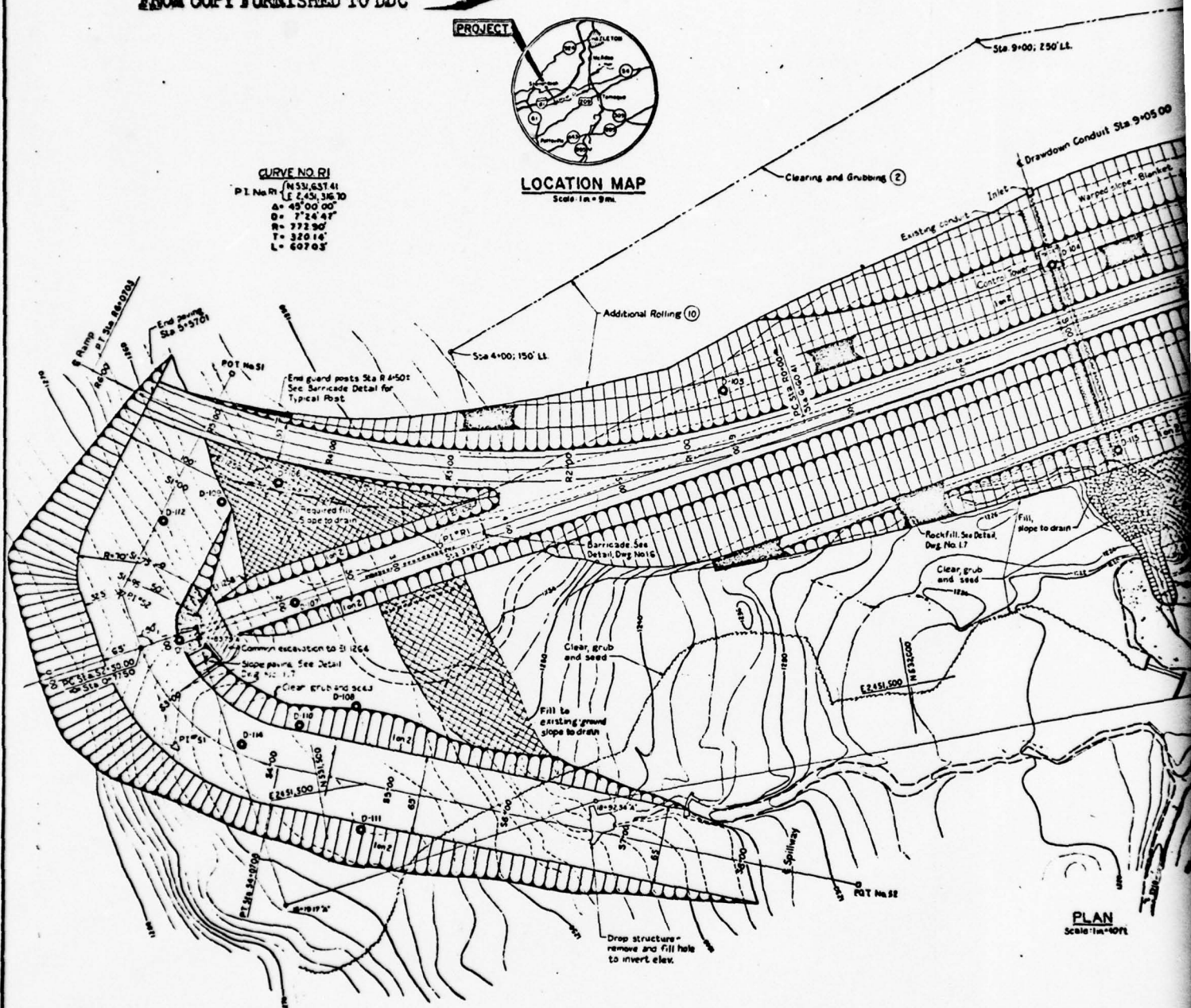
PLATE I

PROJECT



LOCATION MAP
Scale: 1 in. = 9 mi.

CURVE NO. R1
 P.I. No. R1 { N 531.637 41
 E 2.451 316 70
 Δ = 45° 00' 00"
 R = 7° 24' 47"
 R = 772 90'
 T = 320 14'
 L = 607 03'



PLAN
Scale: 1 in. = 40 ft

POT NO 51
N 531.489 64
E 2451.145 74
54m 50°00'

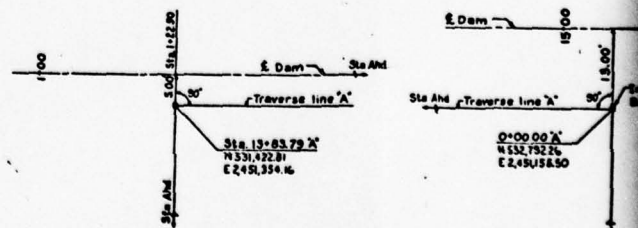
PL NO. 52
N 531,370.28
E 2451,307.39
 $\Delta = 45^{\circ} 00' 00''$
Sta 52+01.08

CURVE NO. 51
 P.L. No. 51 { N 531.350 S1
 E 2451.441 S6
 $\Delta = 60^{\circ} 00' 00''$
 $R = 36^{\circ} 12'$
 $D = 150.00'$
 $T = 86.60'$
 $L = 157.08'$

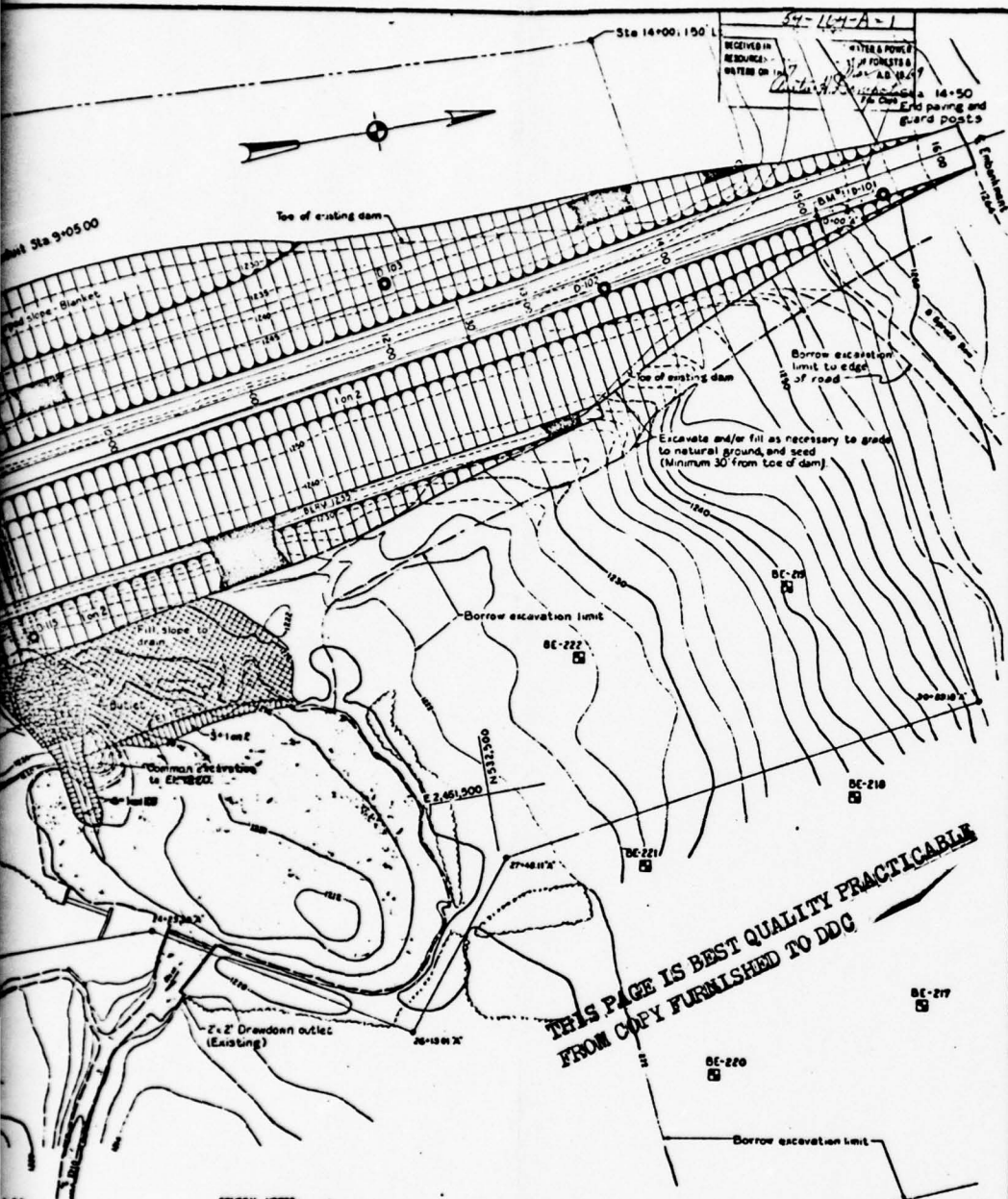
POT. NQ 52
N 531,930.60
E 2,451,662.57
Sta. 89+00

TRAVERSE DATA

Traverse Station	Coordinates	
	North	East
0+00.00 A	532,772.26	2,451,155.49
3+83.79 A	531,422.81	2,451,354.16
6+19.17 A	531,456.59	2,451,583.11
18+92.34 X	531,726.94	2,451,547.89
24+23.33 A	532,257.92	2,451,551.38
26+13.01 A	532,619.58	2,451,650.61
27+48.11 X	532,503.82	2,451,544.99
30+89.18 X	532,844.55	2,451,547.33



CONTROL FOR EMBANKMENT CENTERLINE



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GENERAL NOTES:

1. All elevations shown are based on current U.S.S. datum. Elevations of the features are to be taken from bench marks shown.
2. Data concerning existing drainage pipe has been obtained from available information. Accuracy of these data is not guaranteed.
3. Minor adjustments in alignment may be made to facilitate construction with the approval of the Engineer.
4. "X" indicates payment items.
5. The Contractor when directed, shall fill and grade areas adjacent to new construction for drainage.
6. All soil and spoil areas to be secured by the Contractor.



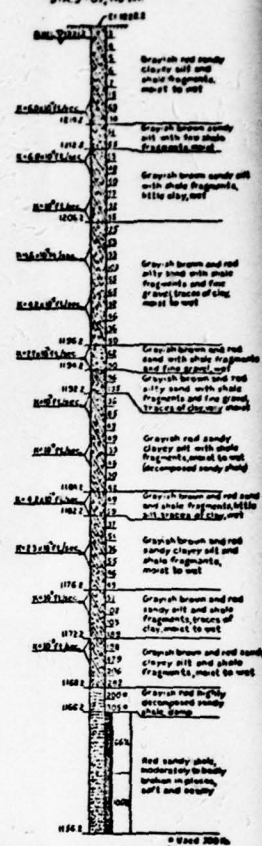
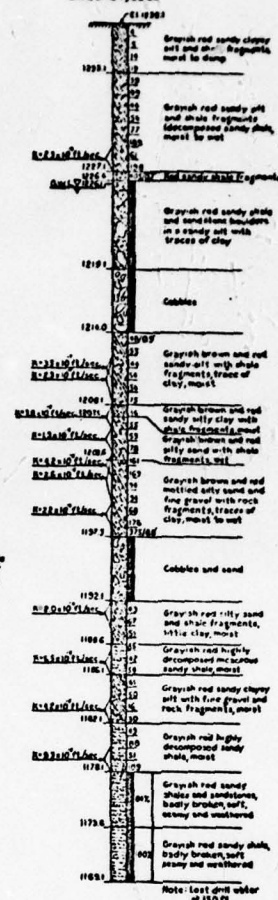
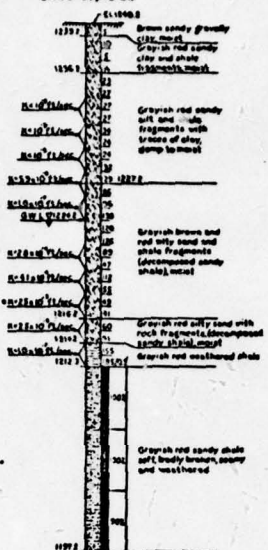
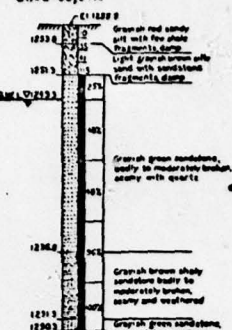
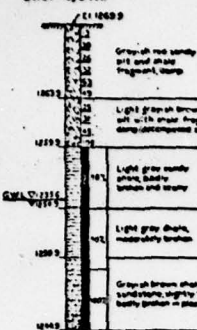
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LOCUST LAKE DAM
COMMONWEALTH OF PENNSYLVANIA

PLAN

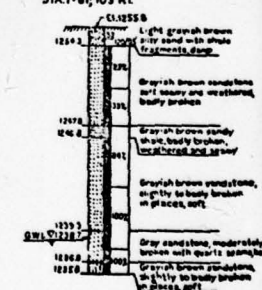
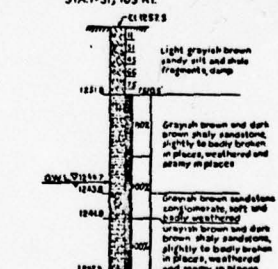
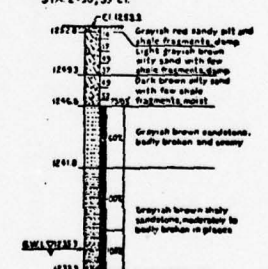
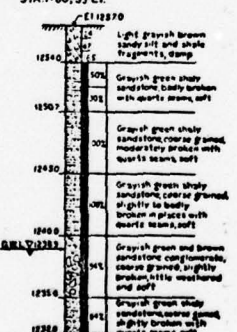
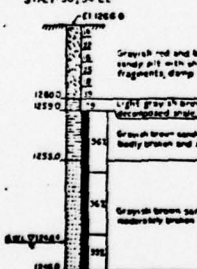
SEPTEMBER 1978

PLATE 2

NO.	DATE	REVISION	BY	CHK.	APP.

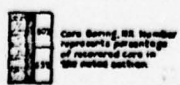
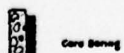


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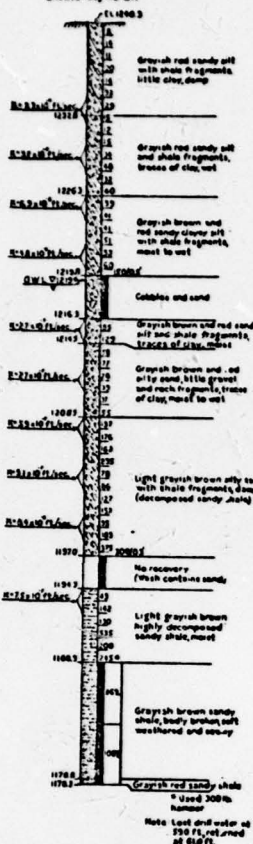


BORINGS - SPILLWAY

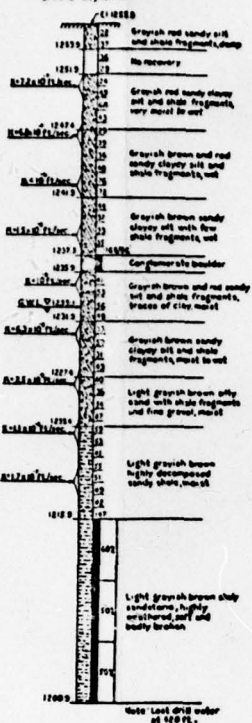
DRILLING LEGEND



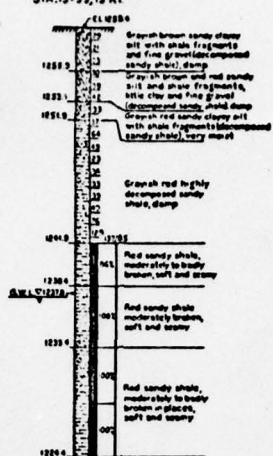
BORING NO D-103
STA 12+05, 40 FT.



BORING NO D-102
STA 13+55, 42 FT.



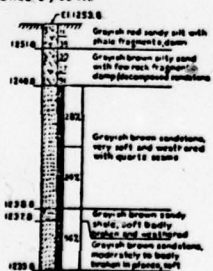
BORING NO D-101
STA 15+55, 42 FT.



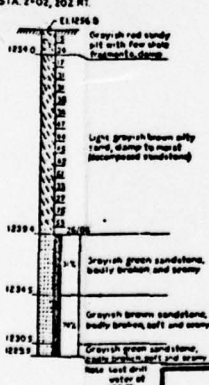
54-164-A-2
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OF COUNTY
WATER -
AUTUMN 1978
J. H. H. H.

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BORING NO D-108
STA 2+31, 103 FT.



BORING NO D-111
STA 2+02, 102 FT.



**PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**

**LOCUST LAKE DAM
COMMONWEALTH OF PENNSYLVANIA
SUBSURFACE EXPLORATION
SHEET 1 OF 2**

SEPTEMBER 1978

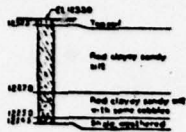
PLATE 3

SUBSURFACE NOTES:

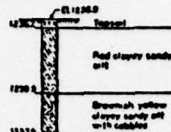
- The subsurface program was accomplished, drive and/or core borings from June 18 thru July 18, 1968 and the borrow exploration from Dec. 3 thru Dec. 5, 1968. Ground water levels and those observed at that time and may not reflect stable ground water levels at the time of investigation or conditions at the time of construction. They are given for general information only.
- Letter in front of boring No. indicates method of drilling D-Drive and/or Core Boring, B.C. - Borrow Exploration.

NO.	DATE	REVISION	BY	CHK.	APP.

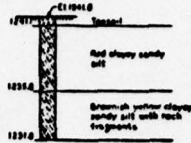
BORING NO. BE-217



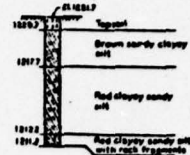
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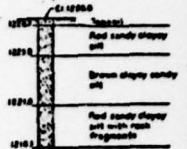
BORING NO. BE-219



BORING NO. BE-220

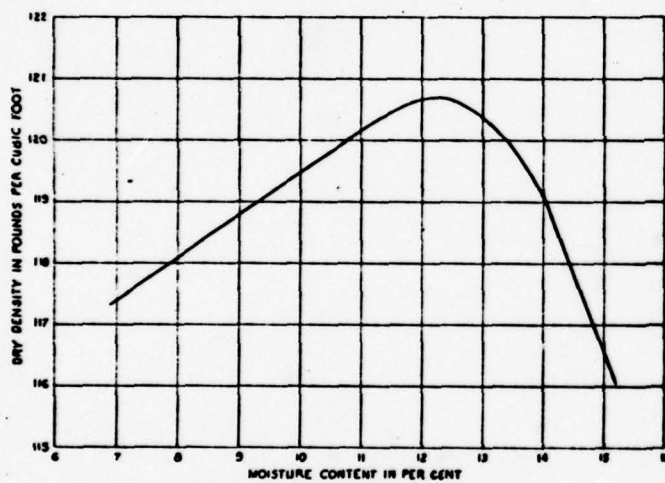


BORING NO. BE-221



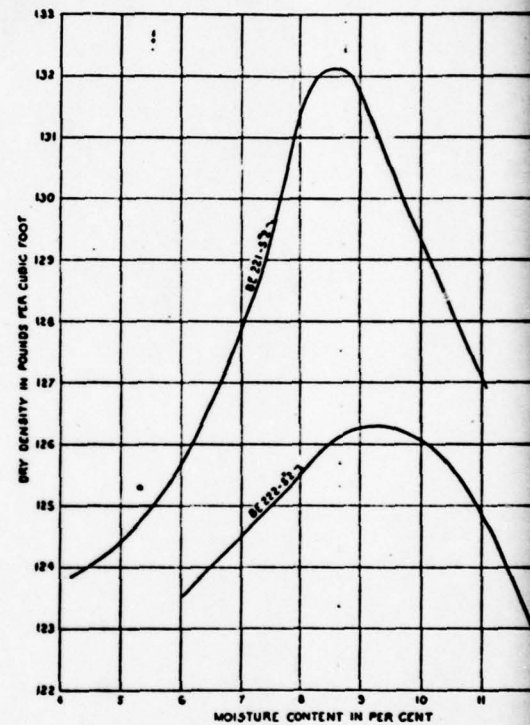
BORROW EXPLORATION

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STANDARD COMPACTION CURVE
ASTM Designation D698, Method A (1 1/2" Material)

BE 213-S1
Maximum dry density.....120.7 lb/ft³
Optimum moisture.....12.1%



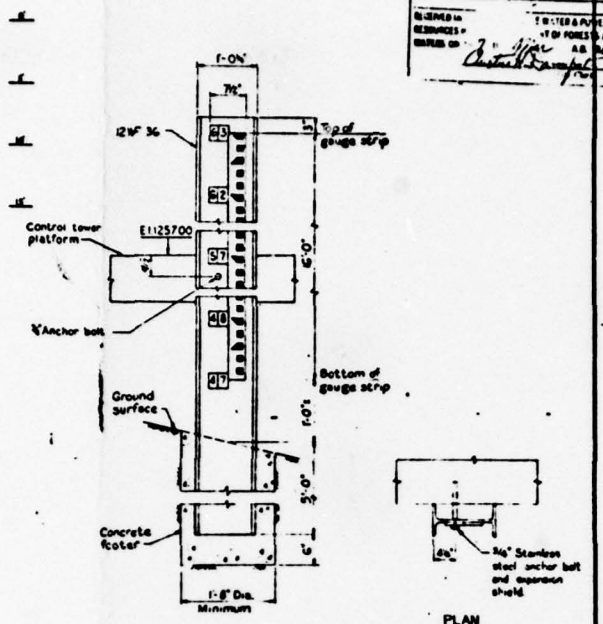
STANDARD COMPACTION CURVES
ASTM Designation D698, Method A (1 1/2" Material)

BE 221-S2
Maximum dry density.....132.1 lb/ft³
Optimum moisture.....8.8%

BE 222-S2
Maximum dry density.....126.3 lb/ft³
Optimum moisture.....8.2%

BORING NO. BE-222

1272	Top soil
1265	Red clayey sandy soil
1252	Brown clayey sandy soil
1242	Dark brown clayey sandy soil with rock fragments
1210	Refill



ELEVATION

PLAN

STAFF GAUGE DETAILS (3)
Scale: 1 in. = 1 ft.

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NOTES:

1. Plan.....Pg. No. 1.1
2. Subsurface Exploration.....Pg. No. 1.2
3. Borehole Coring.....Pg. No. 1.3
4. Cross Sections.....Pg. No. 1.4

NOTES:

1. Subsurface Notes, are shown on Pg. No. 1.2.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

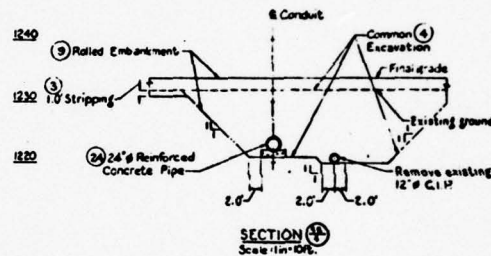
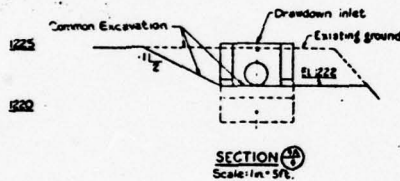
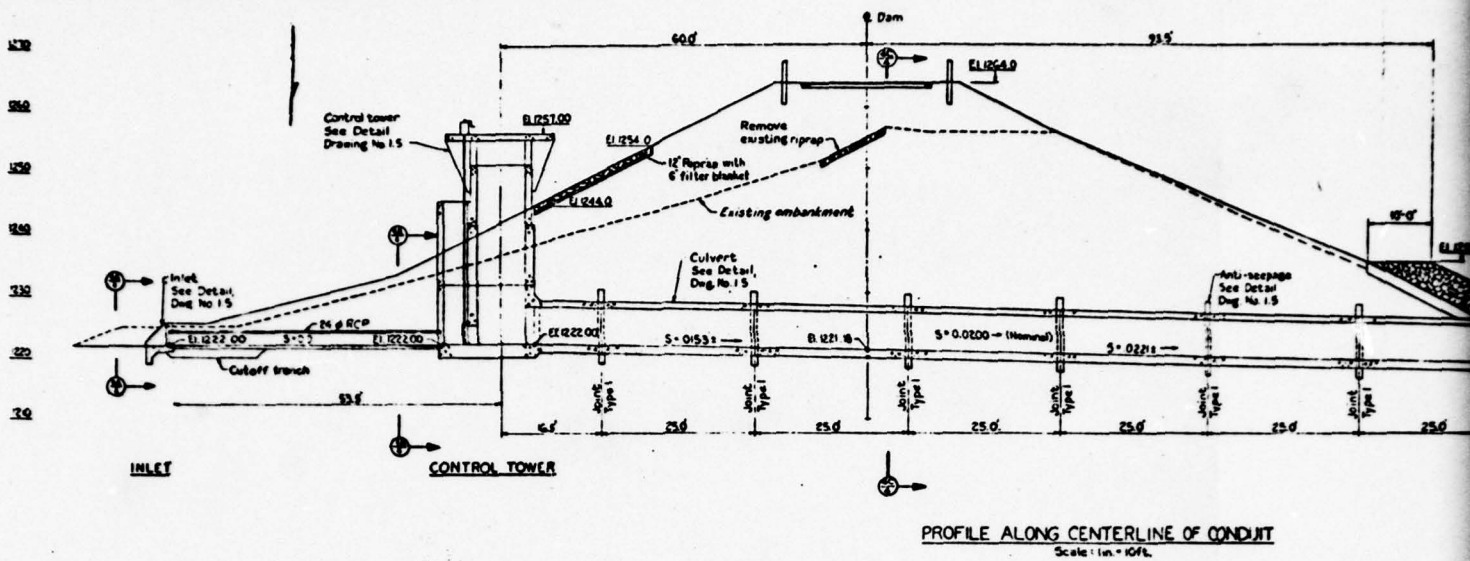
LOCUST LAKE DAM
COMMONWEALTH OF PENNSYLVANIA

SUBSURFACE EXPLORATION
SHEET 2 OF 2

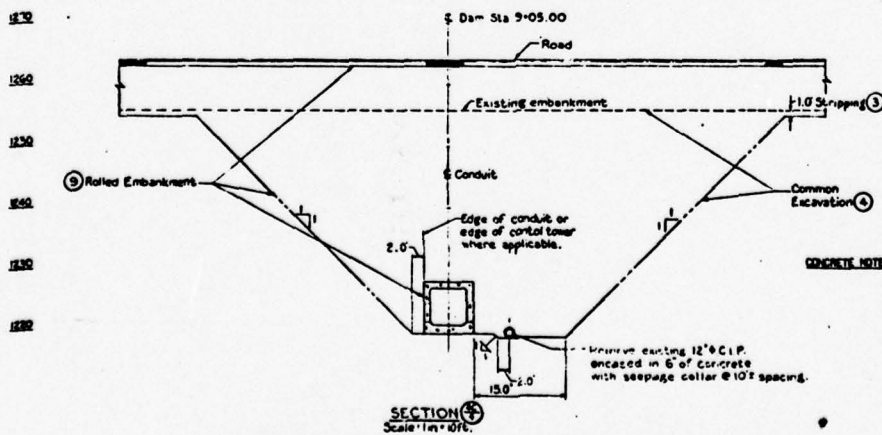
SEPTEMBER 1978

PLATE 4

NO.	DATE	REVISION	BY	CHK.	APP.



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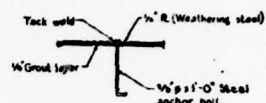
CONCRETE NOTES:

1. All concrete is Class A Concrete, payment item 1111.1, Factor (1).
2. Chapter all exposed sides, horizontal and vertical joints in walls 2" unless otherwise noted.
3. All exposed sides joints to be rounded with concrete edge.
4. All steel reinforcement is 2" clear (edge of steel to surface of concrete) unless otherwise noted.
5. All splices in the reinforcement are not necessarily shown. Location of splices shall be determined by the Contractor in accordance with the Specifications, subject to approval by the Engineer.
6. The minimum reinforcement splice length shall be 30 diameters of the largest bar in the splice.
7. Reinforcement steel shall be paid for under pay item 1111.2.
8. All joint concrete sections shall be poured no less than 10 days apart.
9. C&G. Denotes concrete finish, see standard specifications.






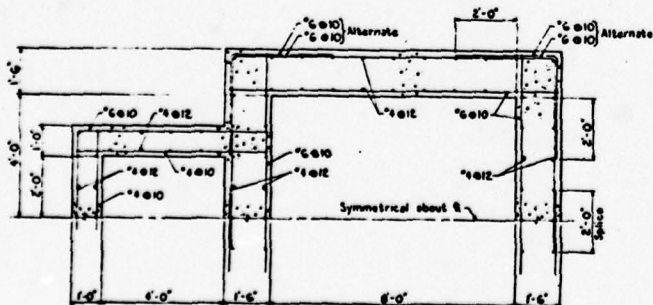
SECTIONAL ELEVATION
Scale: 1 in. = 1 ft.




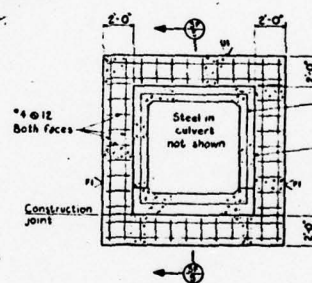
SECTION 
Scale: 1 in. = 1 ft.

SECTION 
Scale: 3/4" = 1'-0"

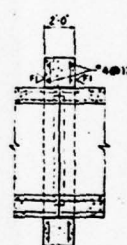
SECTION 
Scale: 1/2" = 1' 0"



SECTION 
Scale: 9 in. = 1 ft.

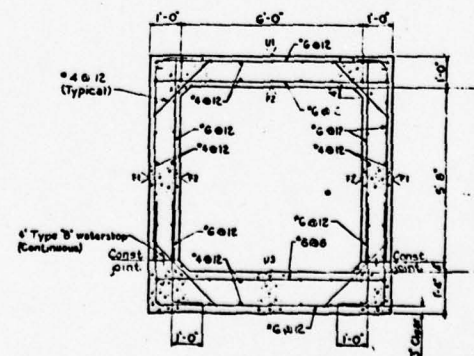


ELEVATION



SECTION 4

ANTI-SEEPAGE COLLAR
Scale: H.W. = 1 ft.



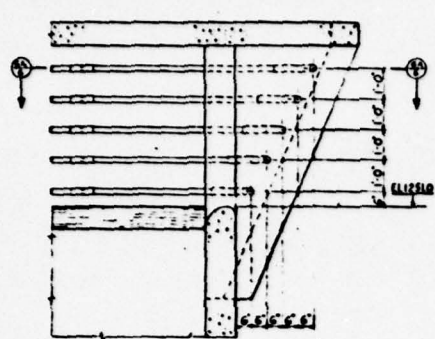
CULVERT DETAIL
Scale: Plan = 1"=10'

REFERENCES

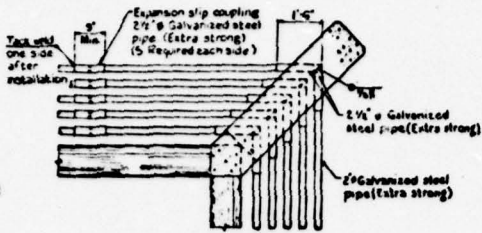
1. Fish, *perca*
2. *Grandis* *Condit.*
3. *Miscellaneous* *Red*

NOTE

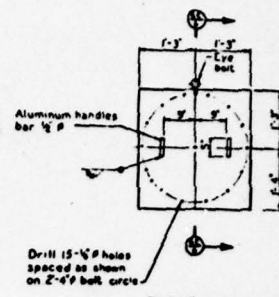
1. For General Notes.
2. For Concrete Notes.
3. Diameter of casing shall be 4" larger



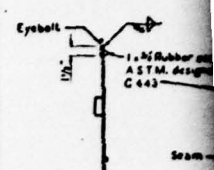
SECTIONAL ELEVATION



SECTION 2



FRONT ELEVATION

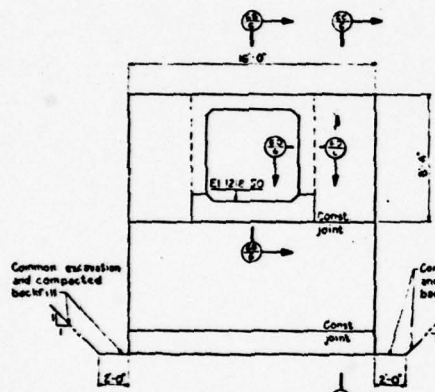


SECTION 3

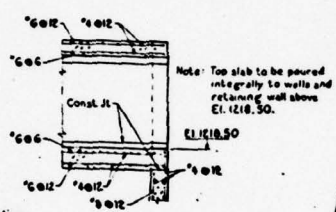
TRASH RACK DETAILS
Scale: 1/4" = 1'-0"

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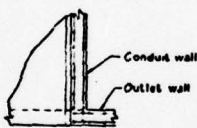
TEMPORARY BULKHEAD
Scale: 1/4" = 1'-0"



FRONT VIEW

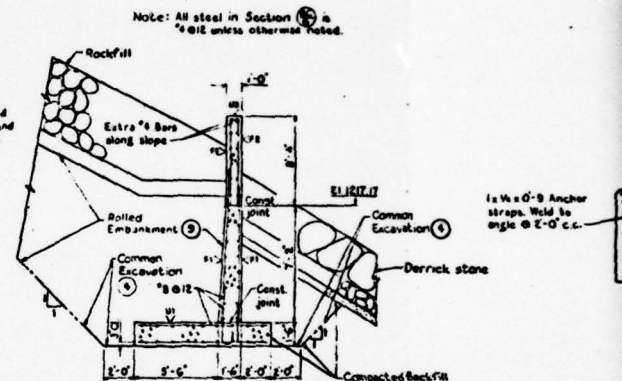


SECTION 1A

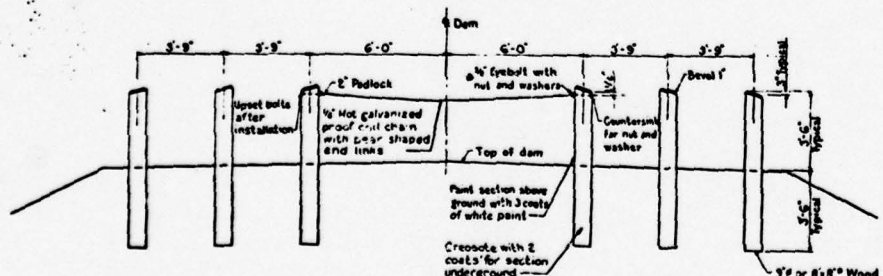


SECTION 1B

OUTLET DETAILS
Scale: 1/4" = 1'-0"



SECTION 1C

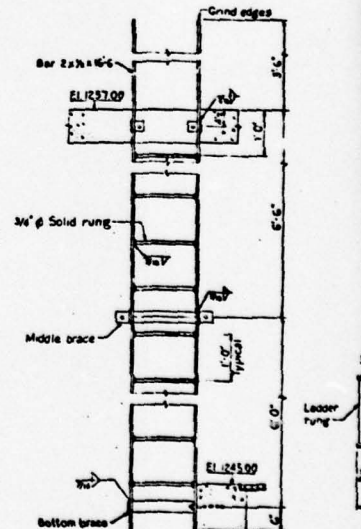


BARRICADE DETAIL 20
Scale: 1/4" = 1'-0"

TYPICAL POST 21

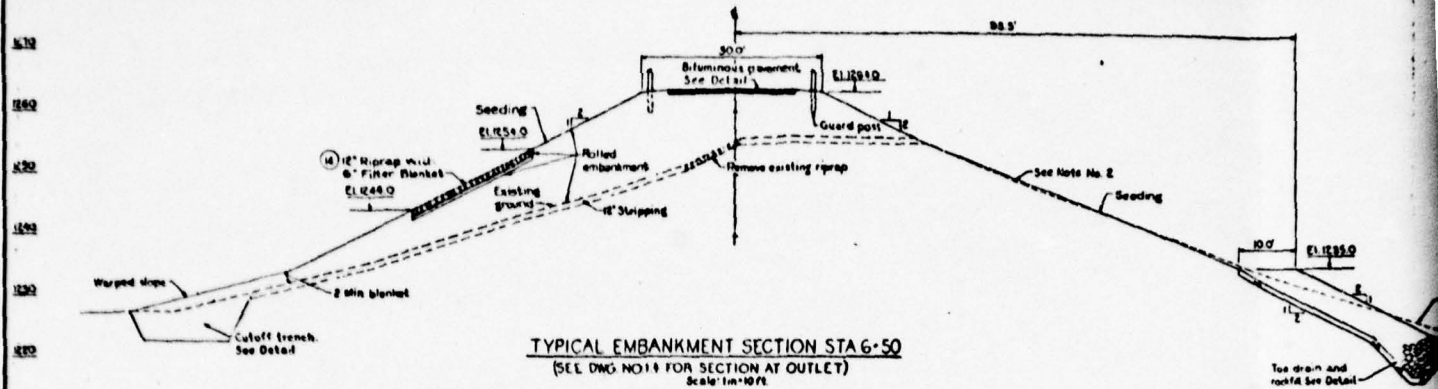
- NOTES:
1. Plan.....Fig. No. 1.1.
 2. Groundwork.....Fig. No. 1.2.
 3. Central Tower.....Fig. No. 1.3.
 4. Cross Sections.....Fig. No. 1.4.

NOTE: 1. For Concrete Notes, see Fig. No. 1.5.

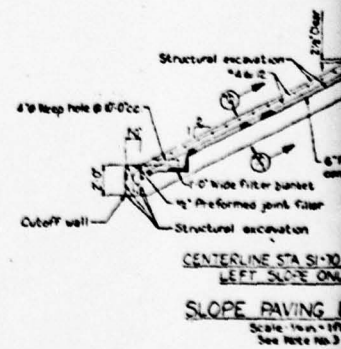
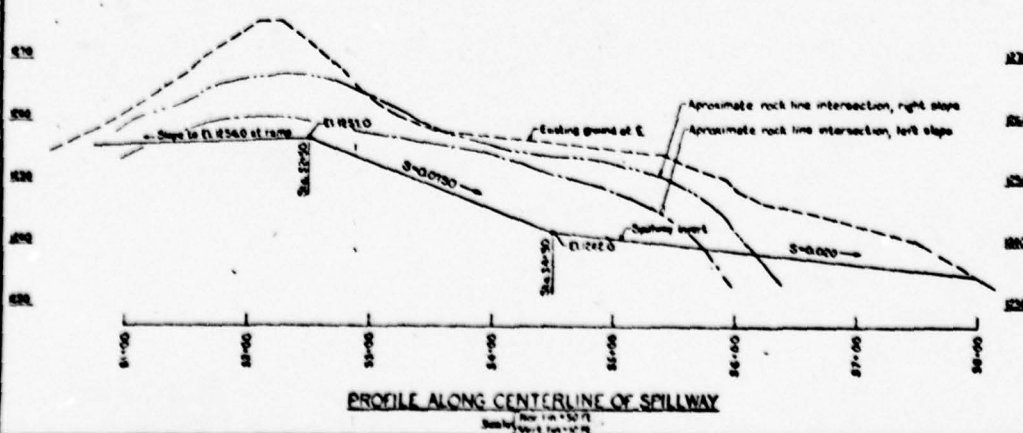
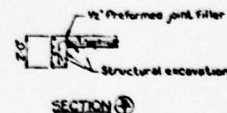
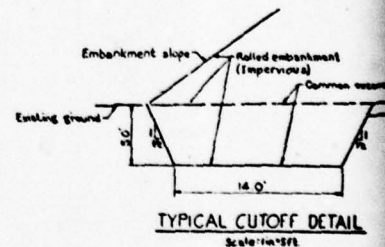
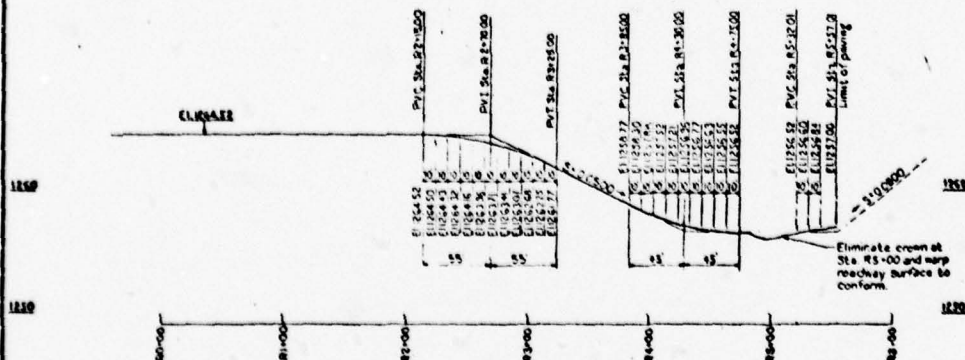
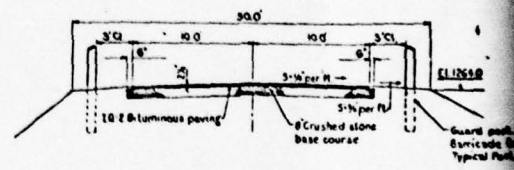
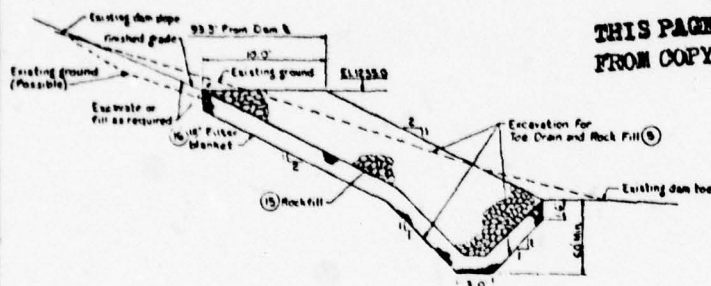


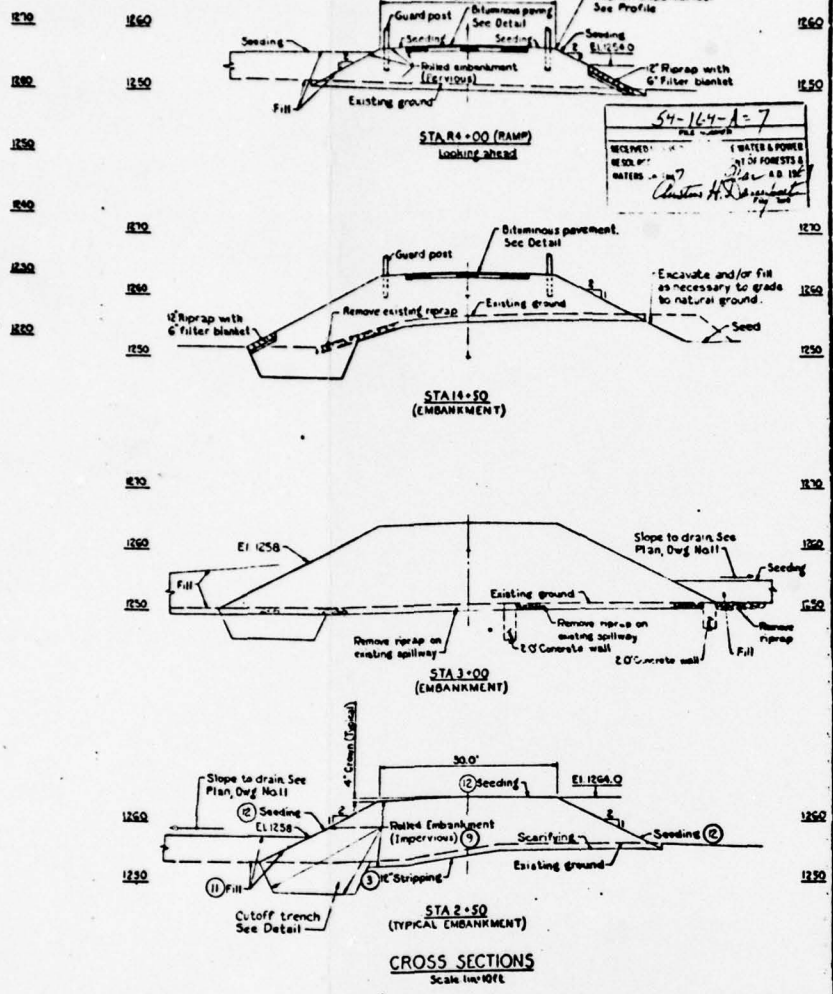
FRONT VIEW

LADDER 'B' 1
Scale: 1/4" = 1'-0"

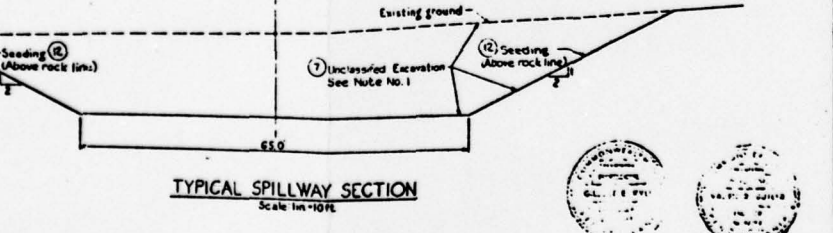


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- REFERENCES:**
1. Plan.....Dwg. No. 1.1.
 2. Subsurface Exploration.....Dwg. No. 1.2 and 1.3.
 3. Groundwater Control.....Dwg. No. 1.4.
 4. Miscellaneous Details.....Dwg. No. 1.5.
- NOTES:**
1. Where the roadway lies above the spillway excavation, the unclassified excavation limit will be to the spillway bottom.
 2. Clear and grub downstream slope of existing embankment between top of slope and rockfill.
 3. Four paving in four equal sections. Separate by construction joints.

PAVING DETAILS

Scale: 1/4" = 1'-0"

See Note No. 3

NO.	DATE	REVISION	BY	CHK.	APP.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LOCUST LAKE DAM
COMMONWEALTH OF PENNSYLVANIA

CROSS SECTIONS

SEPTEMBER 1978

PLATE 8

DELAWARE RIVER BASIN
LOCUST CREEK, SCHUYLKILL COUNTY
PENNSYLVANIA

LOCUST LAKE DAM

NDS ID No. PA-00666
DER ID No. 54-164

COMMONWEALTH OF PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SEPTEMBER 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION PHASE I

NAME OF DAM: Locust Lake Dam

NDS ID NO.: PA-00666 DER ID NO.: 54-164

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	Construction drawings available for original dam and 1969-1970 modifications.
REGIONAL VICINITY MAP	Project is shown on USGS Quadrangle Sheets Shenandoah, Pa., N4045-W7607.5/7.5, 1955, Photo revised 1969; and Delano, Pa., N4045-W7600/7.5, 1954, Photo revised 1969.
CONSTRUCTION HISTORY	Constructed 1954 by Marchalonis Brothers; Modified 1969-1970 by Commonwealth of Pennsylvania, Depart of Forests and Waters, Bureau of State Parks.
TYPICAL SECTIONS OF DAM	Available.
OUTLETS: Plan Details Constraints Discharge Ratings	Available.

ENGINEERING DATA

Sheet 2 of 4

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None.
DESIGN REPORTS	None.
GEOLOGY REPORTS	1969: Permit application report has general and site geology.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	None.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	Boring records for 1968 investigations. Compaction curves for borrow materials are on contract drawings.
POSTCONSTRUCTION SURVEYS OF DAM	None.

ENGINEERING DATA

Sheet 3 of 4

ITEM	REMARKS
BORROW SOURCES	Downstream from dam for 1969-1970 modifications.
MONITORING SYSTEMS	Staff gage.
MODIFICATIONS	1969-1970: Spillway reconstructed; embankment raised 8 feet; outlet works constructed.
HIGH POOL RECORDS	June 1972: Elevation 1253.0 Sept. 1975: Elevation 1251.17
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None.

ENGINEERING DATA

Sheet 4 of 4

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	Available.
SPILLWAY: Plan Sections Details	Available.
OPERATING EQUIPMENT: Plans Details	Available.
PREVIOUS INSPECTIONS Dates Deficiencies (Continued on Sheet A-5)	<p>10/58: No riprap on upstream slope; spillway not complete; no leakage.</p> <p>4/61: Spillway incomplete; spillway channel obstructed with screen.</p> <p>5/62: Spillway meets requirements; slight leakage at toe at right abutment. Note: Major modifications 1969-1970.</p> <p>4/71: No deficiencies; no water in reservoir.</p> <p>5/72: Five seepage areas on downstream slope; erosion gullies on downstream slope.</p> <p>11/72: No deficiencies (Part Subt.)</p> <p>6/73: Three seepage areas on downstream slope; small trees on downstream slope. (Part Supt.)</p> <p>6/73: Several seepage areas on downstream slope 200 feet left of emergency spillway; overgrowth on downstream slope; erosion at end of plunge pool. (Division of Completed Projects (DCP)).</p>

ENGINEERING DATA

Sheet 4a of 4

ITEM	REMARKS
PREVIOUS INSPECTIONS (Continued from Sheet A-4)	12/73: Same as 6/73 (Park Supt.) 5/75: Wet area downstream from dam 100 feet of outlet structure (DCP). 12/75: No deficiencies (Park Supt.) 7/76: No seepage; trees and brush on slopes; riprap displaced at outlet structure (DCP). 11/76: Special conduit inspection by DCP. Intake tower good; seepage and possible piping at top of third conduit joint from tower; repaired before report made. 12/76: No deficiencies (Park Supt.)

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF DAM: Locust Lake Dam NDS ID NO.: PA-00666 DER ID NO.: 54-164

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): Elevation 1251.0.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Elevation 1264.0.

ELEVATION MAXIMUM DESIGN POOL: Elevation 1261.5.

ELEVATION TOP DAM: Elevation 1264.0.

SPILLWAY CREST:

- a. Elevation Elevation 1257.0.
- b. Type Earthen channel.
- c. Width 65 feet.
- d. Length Channel 800 feet long.
- e. Location Spillover Right abutment.
- f. Number and Type of Gates None.

OUTLET WORKS:

- a. Type Drop inlet and 6-foot square conduit.
- b. Location Center of dam.
- c. Entrance Inverts Intake at El. 1251.0; Drops to El. 1222.0.
- d. Exit Inverts El. 1218.5.
- e. Emergency Draindown Facilities 24-inch RCP leads to outlet conduit.

HYDROMETEOROLOGICAL GAGES:

- a. Type Staff gage.
- b. Location Intake structure.
- c. Records Unknown.

MAXIMUM NONDAMAGING DISCHARGE: 5,380 cfs.

DELAWARE RIVER BASIN
LOCUST CREEK, SCHUYLKILL COUNTY
PENNSYLVANIA

LOCUST LAKE DAM

NDS ID No. PA-00666
DER ID No. 54-164

COMMONWEALTH OF PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SEPTEMBER 1978

APPENDIX B
CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Locust Lake Dam County: Schuylkill State: Pennsylvania
 NDS ID No.: PA-00666 DER ID No.: 54-164
 Type of Dam: Earthfill Hazard Category: High
 Date(s) Inspection: 17 August 1978 Weather: Clear Temperature: 78° F
 Camera 1: Canon FTb with 35 mm lens and Kodachrome 64 color slide film
 Camera 2: Minolta SR-T 101 with 28 mm lens and Plus-X black and white print film
 Pool Elevation at Time of Inspection: 1251.1 msl/Tailwater at Time of Inspection: 1218.0 msl
 General Soil Condition: Dry
 Inspection Personnel:
D. B. Wilson (GFCC) A. H. Moeller (Part Supt.)
D. R. Ebersole (GFCC) D. F. Harris (Park Foreman)
 R. D. Rahn (Div. Comp. Proj. - PennDER)
J. M. Crouse (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	Surface erosion area 5' wide, 20' long, and maximum 8" deep at d/s toe near the left abutment. Elevation of erosion area is slightly above rockfill toe.	Relatively minor problem
CREST ALIGNMENT: Vertical Horizontal	No abnormalities.	
RIPRAP FAILURES	None.	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	No abnormalities.	
ANY NOTICEABLE SEEPAGE	Wet area at downstream toe from 100' to left to 180' to left of outlet structure. The clear water is 2" deep in an open ditch that is 2-1/2' wide, 80' long and 1' deep. No discernable flow.	Open ditch joins a rock-filled drainage ditch that is 3-1/2' wide that extends to a small lake that is downstream of the dam.
STAFF GAGE AND RECORDER	Staff gage located on downstream face of intake tower. Reading on day of inspection was 1251.1'.	
DRAINS	Open drainage ditch - described above under ANY NOTICEABLE SEEPAGE. Rockfill at toe with 18" filter blanket. Also, rock-fill drainage ditch system d/s of toe to left of outlet works. (Continued on Page B-9)	Rockfill drainage ditch system built in 1972 after initial observance of wet area.
SLOPES	Combination of grass, weeds, and crownvetch on slopes of embankment. Average height is about 2 feet.	Riprap on upstream slope of embankment does not extend to top of dam.

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Crack on right wall of outlet conduit about 40' upstream from outlet. Crack is about 3' high and is fine. No differential movement or seepage.	
INTAKE STRUCTURE	Crack on downstream face of deck where staff gage is bolted to intake tower. Crack is 2' long and 1/8" wide.	Small surface crack on top of deck over air vent at southeast corner of intake tower. Crack is 18" long and quite fine.
OUTLET STRUCTURE	No abnormalities.	
OUTLET CHANNEL	Outlet works discharges into stilling pool. Immediately below stilling pool, flow enters a small lake.	
EMERGENCY GATE	Two men opened 24" x 36" slide gate two inches in 10 minutes.	

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None.	
APPROACH CHANNEL	Flat and clear.	
DISCHARGE CHANNEL	Clear. The channel is grassed, and the sod is intact and in good condition.	
BRIDGE AND PIERS	None.	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	Nonrecording raingauge at sewage treatment plant on right hillside downstream of dam.	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep to moderate slopes; no evidence of creep, rock slides, or land slides.	
SEDIMENTATION	No sediment problem reported by Owner.	
WATERSHED DESCRIPTION	The watershed is predominately forested. About 60 acres have been developed into a state park in the immediate vicinity of the dam.	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
<p>CONDITION:</p> <p>Obstructions</p> <p>Debris</p> <p>Other</p>	<p>There is a small lake immediately downstream of the stilling pool. The small lake is formed by a small dam, DER 54-162, built around 1948 by the Marchalonis Brothers.</p>	<p>It appears that the small lake would not significantly reduce discharges from the outlet works.</p>
<p>SLOPES</p>	<p>Mild.</p>	
<p>APPROXIMATE NUMBER OF HOMES AND POPULATION</p>	<p>Several homes are located about 1/2 mile downstream of dam. Other inhabitable structures are scattered throughout Locust Creek Valley.</p>	<p>Tamaqua is approximately 9 miles downstream.</p>

VISUAL EXAMINATION OF DRAINS	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
(Continued from page B-3)	<p>The main component of the rock-fill drainage ditch system is a 3-1/2' wide, 80' long rockfill ditch that extends from the toe area to a small lake d/s from the dam. The main ditch is about 100' to the left of the outlet works. A lateral rockfill ditch is located 30' from the toe and extends 30' to the left. A second lateral rockfill ditch is located 50' from the toe and extends 20' to the right.</p>	

DELAWARE RIVER BASIN
LOCUST CREEK, SCHUYLKILL COUNTY
PENNSYLVANIA

LOCUST LAKE DAM

NDS ID No. PA-00666
DER ID No. 54-164

COMMONWEALTH OF PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SEPTEMBER 1978

APPENDIX C
HYDROLOGY AND HYDRUALICS

**GANNETT FLEMING CORDRY
AND CARPENTER, INC.
HARRISBURG, PA.**

SUBJECT LOCUST LAKE DAM (54-164) FILE NO. 7613.5C
HYDROLOGY AND HYDRAULICS ANALYSIS SHEET NO. 1 OF 2 SHEETS
 FOR USE - BALTIMORE DISTRICT
 COMPUTED BY JAC DATE 8/18/78 CHECKED BY gzw DATE 9/78

CLASSIFICATION

HIGH HAZARD, SINCE DOWNSTREAM POPULATION IS SUBSTANTIAL, AND FAILURE OF THE DAM COULD RESULT IN MORE THAN A FEW LIVES LOST AND EXCESSIVE ECONOMIC LOSS

INTERMEDIATE SIZE, SINCE HEIGHT = 96 FEET AND CAPACITY = 1,400 AC-FT
 REFERENCE: "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS," p. D-8

SPILLWAY DESIGN FLOOD (SDF)

THE SDF SHOULD BE THE PMF (FROM p. D-12 OF "REC. GUIDELINES...")

HYDROLOGY AND HYDRAULICS ANALYSIS

REFERENCE: PHASE I PROCEDURE PACKAGE

II. A. 2. PMF INFLOW HYDROGRAPH NOT AVAILABLE

4. BALTIMORE CONTACT RECOMMENDS TRANSPORTING A PMF PEAK FROM A WATERSHED IN THE SCHUYLKILL RIVER BASIN, WHERE THE DRAINAGE AREA = 4.8 SQ. MI. AND THE PMF PEAK INFLOW = 7,200 CFS. THE TRANSPORTATION IS TO A POWER OF 0.8, SO

$$\frac{Q_1}{Q_2} = \left(\frac{D.A._1}{D.A._2} \right)^{0.8}$$

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$$\text{AND, } Q_1 = \left(\frac{D.A._1}{D.A._2} \right)^{0.8} Q_2$$

$$\text{PMF PEAK INFLOW FOR LOCUST LAKE DAM} = Q_1 = \left(\frac{1.7}{4.8} \right)^{0.8} (7,200)$$

$$\text{PMF PEAK INFLOW} = 3,138, \text{ SAY } 3,140 \text{ CFS.}$$

EFFECT OF UPSTREAM RESERVOIRS

NO UPSTREAM RESERVOIRS EXIST

B. ABILITY OF SPILLWAY TO PASS PMF

1. CAPACITY OF SPILLWAYS — REFERENCE: SERVICE & EMERGENCY SPILLWAY RATING CURVES, DER FILES. THE SERVICE SPILLWAY CAPACITY IS 880 CFS AND THE EMERGENCY SPILLWAY CAPACITY IS 4,500 CFS.
 ACTUAL TOP OF DAM ELEV = DESIGN TOP OF DAM ELEV = 1264.0'
 ACTUAL SPILLWAY CRIST ELEV = DESIGN SPILLWAY CRIST ELEV = 1257.0'
 COMBINED SERVICE & EMERGENCY SPILLWAY CAPACITY = 5380 CFS, BUT FOR THE PURPOSES OF THIS STUDY, THE SPILLWAY CAPACITY IS THE EMERGENCY FLOW ALONE = 4,500 CFS

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT LOCUST LAKE DAM (54-164) FILE NO. 1613.50
HYDROLOGIC AND HYDRAULIC ANALYSIS SHEET NO. 2 OF 2 SHEETS
FOR USCE - BARTONVILLE DISTRICT
COMPUTED BY JMC DATE 8/21/78 CHECKED BY D/SW DATE 9/78

2. THE PMF PEAK FLOW IS LESS THAN THE SPILLWAY CAPACITY ($3,140 < 4,500$)
- NO SPILLWAY ROUTING FOR THE PMF IS NECESSARY
 - THE DAM CAN BE ASSURED TO BE ABLE TO PASS THE PMF WITHOUT OVERTOPPING

PERCENT OF PMF THAT SPILLWAY CAN PASS
WITHOUT SURCHARGE STORAGE EFFECT

$$\begin{aligned}\% \text{ OF PMF} &= \frac{Q_{\text{capacity}}}{Q_{\text{PMF}}} \times 100\% \\ &= \frac{4,500}{3,140} \times 100\%\end{aligned}$$

$$\% \text{ OF PMF} = 143 \%$$

NOTE: THE EMERGENCY SPILLWAY ALONE IS CAPABLE OF PASSING THE PMF WITHOUT OVERTOPPING. THEREFORE, THE DAM CAN BE ASSUMED TO BE ABLE TO PASS THE PMF WITHOUT OVERTOPPING EVEN IF THE SERVICE SPILLWAY IS COMPLETELY INEFFECTIVE.

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DELAWARE RIVER BASIN
LOCUST CREEK, SCHUYLKILL COUNTY
PENNSYLVANIA

LOCUST LAKE DAM

NDS ID No. PA-00666
DER ID No. 54-164

COMMONWEALTH OF PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SEPTEMBER 1978

APPENDIX D
PHOTOGRAPHS

LOCUST LAKE DAM

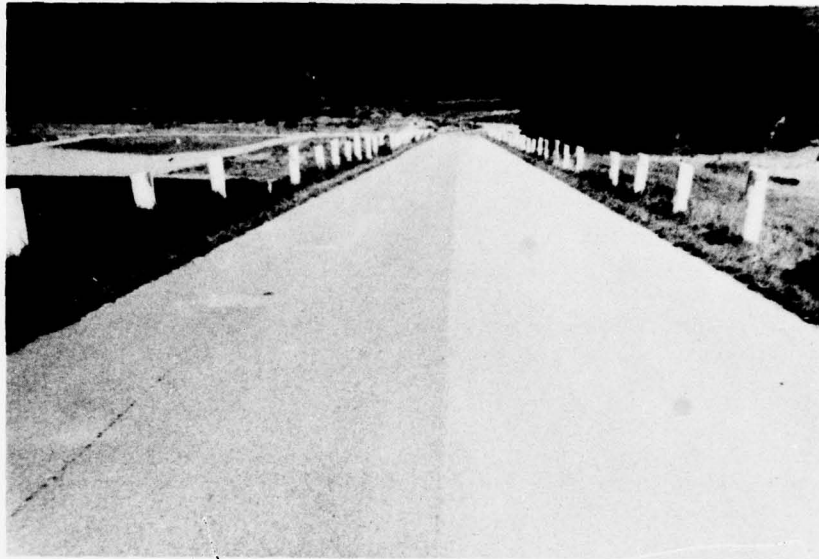


A. Upstream Slope of Embankment.
View from Spillway Approach Channel.



B. Upstream Slope of Embankment View from Left Abutment.

LOCUST LAKE DAM



C. Embankment Crest.
View from Center of Dam.



D. Downstream Slope of Embankment.
View from the Spillway Outlet Channel.

LOCUST LAKE DAM



E. Downstream Slope of Embankment. View from the Left Abutment.

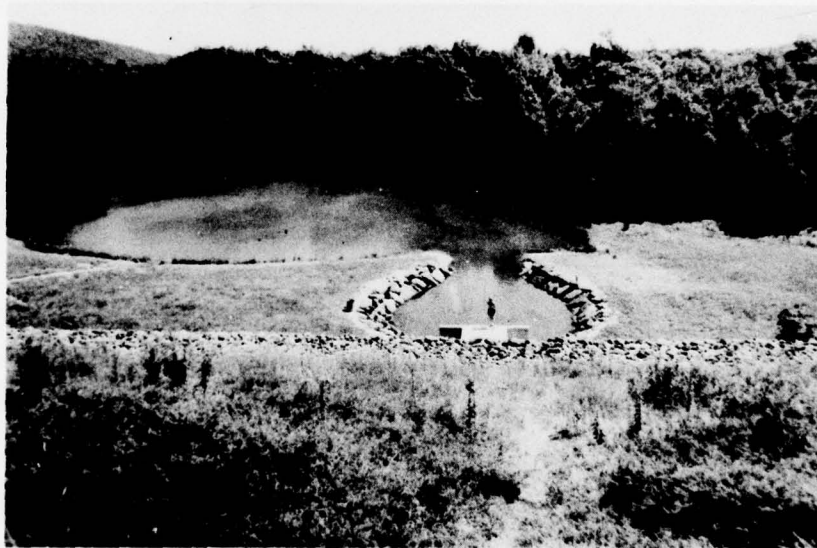


F. Wet Area at the Downstream Toe of Embankment.

LOCUST LAKE DAM



G. Rockfill Drains below the Downstream
Toe of Embankment.



H. Outlet Structure, Stilling Pool, and
Lake below Dam.

LOCUST LAKE DAM

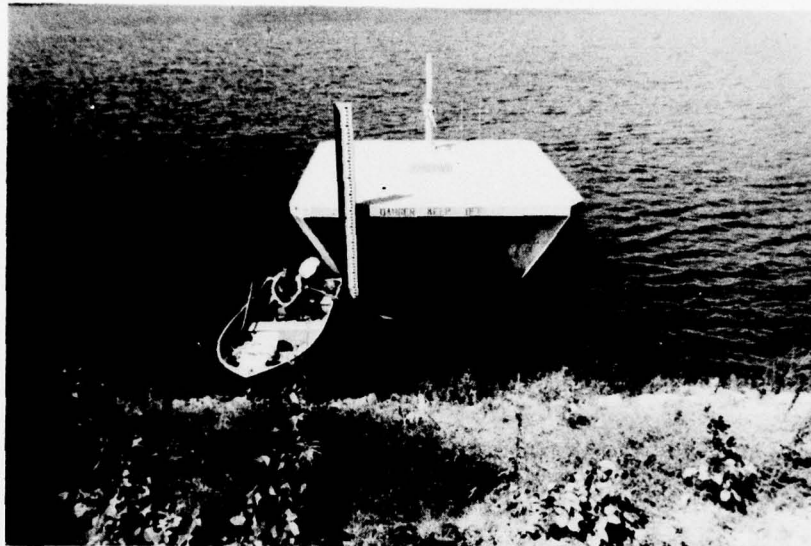


I. Spillway Channel.
View from the Right Hillside.

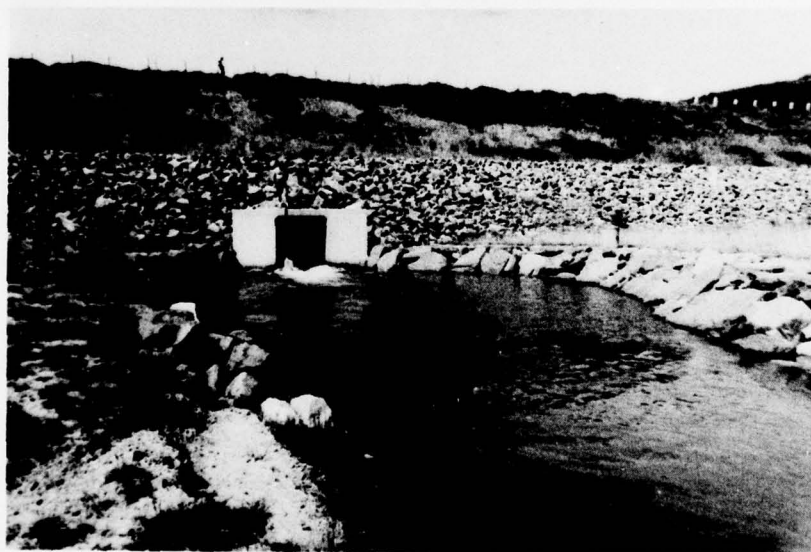


J. Spillway Outlet Channel.
View from the Right Hillside.

LOCUST LAKE DAM



K. Intake Structure and Staff Gage.



L. Outlet Structure and Stilling Pool
during Valve Operation.

DELAWARE RIVER BASIN
LOCUST CREEK, SCHUYLKILL COUNTY
PENNSYLVANIA

LOCUST LAKE DAM

NDS ID No. PA-00666
DER ID No. 54-164

COMMONWEALTH OF PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SEPTEMBER 1978

APPENDIX E

GEOLOGY

LOCUST LAKE DAM

APPENDIX E GEOLOGY

1. General Geology. The dam and reservoir are located in Schuylkill County. The county lies entirely south of the Wisconsin and Illinoian drift borders. The Jerseyan drift border is believed to traverse the middle of the county, but very few definite deposits of drift have been located. The rock formations exposed in Schuylkill County range from the post-Pottsville formations, of Pennsylvanian age, down to the Tuscarora sandstone, of Silurian age. The youngest formations, the post-Pottsville, crop out in the large Southern anthracite field and part of the Western Middle field. The oldest formation, the Tuscarora, crops out along Kittatinny (Blue) Mountain which forms the southern boundary of the county.

The geologic structure of Schuylkill County is complex. The strata have been sharply folded along northeast axes, and the truncated hard and soft beds now form an intricate system of long narrow ridges and valleys. The carboniferous rocks suffer the most intense folding and are overturned in many places. The most important structural feature economically is the large synclinerium of the Southern anthracite field which occupies the center of the county. This basin consists of a number of smaller connected basins, which become successively deeper and have steeper sides as they progress towards the south. In the southern part of the county, the Silurian and Devonian rocks have been folded for some distance on both sides of the Schuylkill River. An anticline passes eastward from Cressona, exposing the Cayuga group and part of the Clinton formation. A syncline extending west from Landingville exposes the Catskill group. The Lehigh anticline of Carbon County extends into Schuylkill County as far as Reynolds. The ridge north of Port Clinton is an anticlinal ridge exposing the Clinton formation, and a syncline crosses the Schuylkill River just north of Port Clinton exposing the Cayuga group.

The geology produces a complex runoff pattern in Schuylkill County whereby there is drainage in five different directions. The northwestern part is drained by Mahantango Creek, and smaller streams, all of which drain into the Susquehanna River north of Harrisburg. The southwestern part is drained by Swatara Creek, which drains into the Susquehanna River south of Harrisburg. The northernmost part is drained by Catawissa Creek, which drains into the North Branch of the Susquehanna River upstream of Danville. The eastern portion of the county is drained by tributaries of the Lehigh River, which in turn drains into the Delaware River near Easton. The central and greater part of the county is drained by tributaries of the Schuylkill River, which, in turn, drains into the Delaware River near Philadelphia.

2. Site Geology. The damsite is underlain by hard gray conglomeratic sandstone and hard red sandy shale stratifications of the Mauch Chunk formation in the highly faulted and folded Southern anthracite field in the center of the county. The area is drained by the Schuylkill River. The axis of a syncline called Locust Lake Syncline follows the approximate original streambed through the damsite and reservoir. The axis of Eisenhuth Anticline is located about 300 feet to the left of Locust Lake Syncline, while an axis of Powder Hill Anticline is located about 300 feet to the right of Locust Lake Syncline. The Pottchunk Fault sweeps across and around this folded and faulted area, passing immediately beyond the left abutment of Locust Lake Dam. The 1,600-foot axis of the dam passes across both anticlines and the syncline, which accounts for the broken condition of the rock and the difficulties experienced in the initial construction with leakage. The conglomeratic sandstone is present in the upper portions of both abutments and the spillway, or anticline areas; while the sandy shale is present in the valley, or syncline area.